# ILLINOIS
# STATE GEOLOGICAL SURVEY

Kenneth E. Clegg

STATE OF ILLINOIS

STATE GEOLOGICAL SURVEY

FRANK W. DE WOLF, Director

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BULLETIN No. 27

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# GEOGRAPHY

OF THE

# UPPER ILLINOIS VALLEY

AND

# HISTORY OF DEVELOPMENT

BY

CARL ORTWIN SAUER

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## LETTER OF TRANSMITTAL

UNIVERSITY OF ILLINOIS, SEPTEMBER 1, 1916.
STATE GEOLOGICAL SURVEY,

*Governor E. F. Dunne, Chairman, and Members of the Geological Commission,*

GENTLEMEN:—I submit herewith a report on the Geography of the upper Illinois Valley and History of Development, by Carl Ortwin Sauer, and recommend that it be published as Bulletin No. 27. The field work was done in 1910 under the general supervision of Professor R. D. Salisbury, consulting geologist. At the time the work was done Mr. Sauer was a member of the Department of Geology of the University of Chicago. He is now Professor of Geography at the University of Michigan.

The present report is one of a series of educational bulletins which have proved very popular with the public.

The science of geography has advanced rapidly within the past few years, and the interest of teachers and laymen is proved by the demand for educational bulletins published by the Survey. The present bulletin will be of interest primarily to residents of the region, but it contains a wealth of geographic material which will be useful to anyone interested in nature study.

Very respectfully,

FRANK W. DEWOLF, *Director.*

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# GEOGRAPHY OF UPPER ILLINOIS VALLEY

**By Carl Ortwin Sauer**

## CHAPTER I—INTRODUCTION

### Purpose of Report

This bulletin has been written for the purpose of giving a non-technical account of the geology, physiography, and geography of the upper Illinois Valley. The region is rather typical of the great Prairie Plains to which the major part of Illinois belongs and is of interest therefore to many who do not have a first-hand acquaintance with the Middle West. The report is intended, however, primarily for those who live in this area, for the farmers of the prairie, for those engaged in the industries of Illinois Valley, and for the teachers and high-school students of the upper river counties who may wish to read the story that is written in the rocks and soils of their home.

### Acknowledgments

The field work on which this report is based was done in the summer of 1910. Professor R. D. Salisbury and Professor H. H. Barrows furnished valuable criticisms and suggestions in the field. Acknowledgment is due to Professor R. D. Salisbury for a careful supervision of the entire work and for the critical reading of the manuscript. Professor H. H. Barrows also revised the last chapter of this bulletin, and made numerous helpful suggestions. To the many residents of the region, who freely aided me in many ways, I wish to extend in cordial remembrance my hearty thanks.

# CHAPTER II—LOCATION AND TOPOGRAPHY

## Location of Area

The region with which this report is concerned is the upper Illinois Valley, located in north-central Illinois, about four-fifths of the way from Ohio River to the Wisconsin State line, and midway between Mississippi River and the Indiana State line. Defined in terms of latitude and longitude, the area lies between meridians 88°10′ and 89°25′ and parallels 41°15′ and 41°30′. The eastern limit of the area included in the bulletin extends somewhat beyond the head of Illinois River (at 88°15′30″ west longitude, and 41°23′30″ north latitude). Likewise the limit on the west overlaps slightly the "Great Bend" of the Illinois (fig. 1).

The upper Illinois Valley is defined for the purposes of this report as that part above the great rectangular bend of the river at Hennepin. In this upper course the river flows almost due west, deviating by only about 6 degrees to the south of this direction. The northernmost point reached by the river is a few miles below its head, at 41°24′ north latitude. A straight line drawn thence to the bend shows the maximum deviation of the river from a straight course to be at Seneca, and this is a departure of less than 5 miles. The east-west direction of the river and the linear nature of its valley have played an important part in the economic development of this region. Figure 1 shows the general location of the area and its relation to other regions on which similar reports have been issued by the State.

In the area is included the greater part of La Salle and Grundy counties, smaller portions of Bureau and Putnam counties, and very minor parts of Kendall and Will counties.

Of the cities and villages, Ottawa is most centrally located and is the county seat of La Salle County. The most important cities of the western region are La Salle and Peru, a single city in all but corporate limits. Farther west is Spring Valley, the largest town in Bureau County. Morris, the county seat of Grundy County, is the only important place in the eastern part of the region.

The United States Geological Survey has divided the region into six rectangular divisions, known as quadrangles,[1] for purposes of uniformity

[1]Of each of these quadrangles, a topographic map (i. e. a map showing features of relief, drainage, and culture) has been prepared by the U. S. Geological Survey, on the scale of one mile to the inch. These maps represent clearly and simply the character of the surface of the region. The U. S. Geological Survey distributes them at 10 cents each.

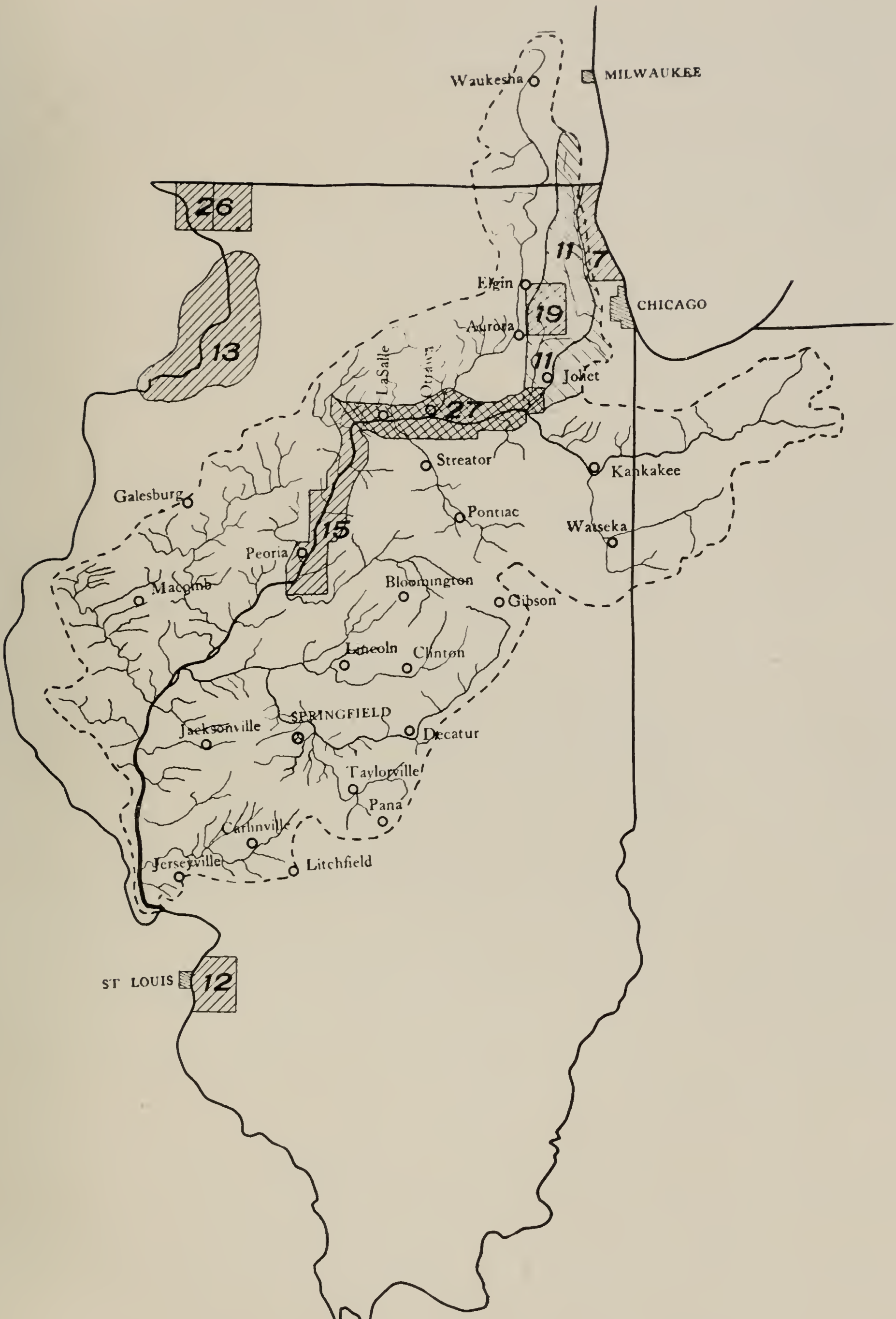


FIG. 1.—General location of Illinois basin and areas described in educational bulletins.

in mapping. Beginning at the east, the quadrangles concerned are: Wilmington, Morris, Marseilles, Ottawa, La Salle, and Hennepin. The shaded area in figure 1 shows the portions of these quadrangles which have been included in the report.

The upper Illinois Valley is known to most residents of Illinois because of the Starved Rock State Park, and the busy industrial district centering about La Salle. It has also a distinguished place in State history because

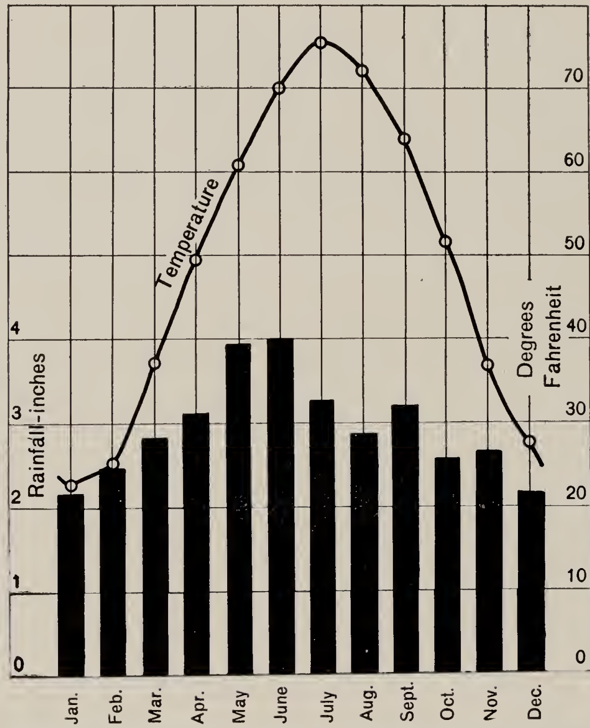


FIG. 2—Graph showing average monthly temperatures and average monthly rainfall at La Salle.

of its rôle in the early settlement of Illinois, and because the once famous Illinois and Michigan Canal terminates within it.

## Location as Determining Climate

The climate of a region is an expression primarily of the various elements of its location. The most important of these are position in latitude, location with reference to large bodies of water and to mountain masses, and position with reference to prevailing and storm winds. Position in middle latitudes a thousand miles inland, a moderately low elevation, the absence of any nearby highlands, and the location in the track of cyclonic storms that come from the west are the leading factors in determining the character of the climate of the Central Prairies, to which the upper Illinois Valley belongs.

The position in intermediate latitudes expresses itself in fairly long winter nights and equally long summer days, and in a sun nearly overhead in summer but shining very obliquely in winter. As a result, the seasons are sharply contrasted. The lengthening of the day in the summer months is a factor of some importance in accelerating the growth of vegetation.

Interior location has given a continental climate with great temperature ranges, strong and shifting winds, and a moderate rainfall. The distinctness between the seasons has thus been emphasized—the winters are cold and characterized by high winds; the summers are hot and have rain storms of irregular occurrence. The accompanying graph (fig. 2) shows average temperatures and rainfall at La Salle for each month in the year.

On the whole, the advantages of such a climate are great. It is well suited to the production of most temperate-zone field products, particularly of grains. The frost-free season of more than five months, the long, hot summer days, the abundance of moisture during the summer months, and the rather sharp lowering of temperatures during the latter part of the fall provide excellent conditions for the growth of Indian corn, the first crop of the State. Droughts come occasionally, but do not constitute a serious agricultural problem. The health and vitality of the people are favored by the invigorating seasonal changes, the purifying strong winds, the wealth of sunshine, and the moderately low humidity of the air. Climatic extremes are not so great that the activity of man is seriously impaired at any time. The energizing influence of the change of seasons is also one of the causes of the thrift and prosperity of the people. As in all similar latitudes, the need of growing a sufficient surplus to tide over the non-productive winter season has stimulated progress. The big barns which liberally dot the prairie landscape and dominate the cluster of buildings around the farm houses speak not only of a sturdy race of farmers and of fertile soils, but as well of the long winters which have taught the farmer providence.

## Relation to Central Plains

Illinois Valley is located almost in the heart of the great Central Plains or prairies. Eastward the prairies stretch to the plateaus on the western flanks of the Appalachians, westward to the high plains that lead up to the Rockies. Southward they merge gradually into the low Gulf Plain, and at the north the prairie joins the timbered uplands of the northern lakes. In all directions the surface features are very similar for hundreds of miles. All about, the region is one of moderate elevation (below 1,000 feet) ; the relief is slight, and the surface rather monotonous The characteristic surface shows a uniformly gentle, billowy outline. Transportation lines cross at will, supplying rail facilities wherever there is sufficient traffic. The prairie region is belted particularly by east-west lines of railways that connect the Middle West with the Atlantic and also the Pacific seaboard.

Similarity of conditions extends to more than surface features. The conditions of climate which have been traced for La Salle (fig. 2) hold with slight variations for the rest of Illinois and for Indiana and Iowa. The agricultural products are very similar for all the interior prairie States. All are poorly supplied with timber and have, as their only great mineral product, coal.

Because of this uniformity of physical conditions, conditions of life have also been similarly uniform throughout the region. The sameness of surface, climate, and resources in the Central Plains has meant a rather even economic development in all parts. The history of the settlement and growth of the upper Illinois basin does not differ in any large measure from that of the adjacent districts. Provincialism has never been a prominent feature. There is a stereotyped quality in all its history, geologic and human, to the present; in a general survey it is essentially the same as that of the surrounding country. It is only in a detailed study that uniformity disappears, and that differences are brought to light which give a stamp of individuality to the region.

## General Features of Illinois Valley

### RELATION TO OTHER DRAINAGE LINES

Centrally located within the prairie region, Illinois River is, next to the Ohio, the most important eastern affluent of the Mississippi. It joins the Mississippi about midway between the source and mouth of that stream, and almost opposite the confluence of the Missouri with the Mississippi. Not far below the Ohio enters the Mississippi. This position of Illinois Valley within the greatest developed river basin of the world is most advantageous. It is located centrally to a long line of waterways, which stretch from the gates of the Yellowstone to the base of the Appalachians, and from St. Paul to the Gulf. The Illinois, however, derives an added importance, because of all parts of the Mississippi Basin it is most intimately associated with the Great Lakes. The outflow from Lake Michigan at times during the Ice Age was directed down Illinois Valley. Even now the headwaters of the Illinois crowd the watershed between the Mississippi Basin and the Great Lakes hard against Lake Michigan. Occasionally the abandoned glacial channel leading from lake to river becomes flooded, and water again flows through it to the Illinois. Here then is an all but continuous natural waterway from Lakes to Gulf, which early attracted the attention of men to its completion.

### DRAINAGE BASIN OF ILLINOIS RIVER

The dotted line in figure 1 encloses the drainage area of Illinois River. This river cutting across the State from northeast to southwest, gathers in the drainage from almost half the State, or about 25,000 square miles. Illinois River proper has its source and mouth within the limits of the State, but the Desplaines and the Kankakee, which form the Illinois, and the Fox River, which is the largest tributary entering its upper course, have their sources outside the State. The Desplaines rises in Wisconsin, and the Kankakee in Indiana; both streams are marginal to Lake Michigan, and their courses are determined by a series of parallel morainic ridges bordering the lake.

The size of the drainage basin has been estimated at 32,081 square miles,[1] supporting in 1910 a population of about one and a half millions. Two-thirds of this territory lies south and east of the river, the shorter slope of the drainage basin being formed by the watershed between the Illinois and the Mississippi rivers.

### DIVISIONS INTO UPPER AND LOWER VALLEY

Sixty-three miles below its head, the Illinois changes its course from westward to southward. The turning point is known as the ''Great Bend'' of Illinois River. Below this point, the valley widens so markedly that even to a casual observer the change is striking. In this report the upper valley is considered as the part above the ''Great Bend.'' In this upper stretch the average and rather uniform width of the valley is about one and one-half miles, except in the flat Morris basin, where there scarcely can be said to be distinct valley sides. Below the bend, as one passes Depue, the change is striking. The valley sides recede, the flood plain becomes two to five miles wide, and within it the river wanders about aimlessly. Here and there the floor of the valley narrows abruptly and re-expands below. In this lower part, the width of the valley is two to four times as great as in the upper part. Since valleys normally widen gradually downstream, the immediate inference drawn from the sudden change in width at the bend is that the lower valley is of much greater age than the upper valley. Other features which distinguish the two parts are: (1) the general absence of rocky bluffs in the lower valley and the prevalence of them in the upper valley; (2) the presence of great gravel terraces in the lower valley, and their absence as conspicuous features along the upper course; and (3) the gradient.

[1] J. W. Hill, in Water Supply and Irrigation Paper 194, p. 315. L. E. Cooley places the estimate at 27,914 miles (Lakes-Gulf Waterway).

## GRADIENT

The change in gradient occurs below the rapids at Starved Rock, and this place has been used in hydrographic surveys to mark a division of the channel into two parts. The gradient of the stream is shown in Table 1.

TABLE 1.—*Gradient of Illinois River for different parts along its course*

| | Distance | Total fall | Fall per mile |
|---|---|---|---|
| | *Miles* | *Feet* | *Feet* |
| From head of Lake Joliet— | | | |
| to Treat's Island | 6.3 | 10.7 | 1.70 |
| to head of Illinois | 6.2 | 7.5 | 1.41 |
| to Marseilles dam | 25.4 | 8.5 | 0.34 |
| to foot Marseilles rapids | 1.5 | 18.6 | 12.40 |
| to foot Starved Rock rapids | 14.6 | 20.2 | 1.30 |
| to end of I. and M. Canal | 7.6 | 1.1 | 0.15 |
| to end of Hennepin Canal (limit of area covered in this report) | 12.9 | 1.4 | 0.10 |
| to Peoria | 47.9 | 2.0 | 0.04 |
| to Grafton | 167.3 | 23.2 | 0.14 |

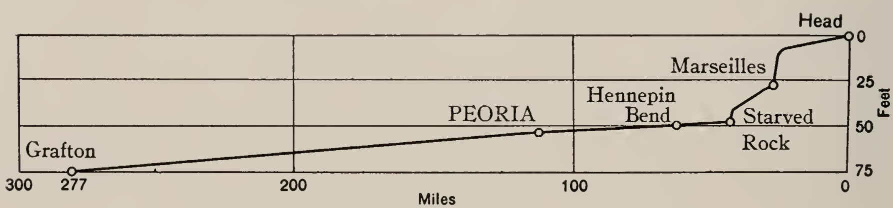


FIG. 3.—Profile showing gradient of Illinois River.

Figure 3 shows the gradient of the Illinois in profile. In the upper 63 miles of its course (that portion within the limits of the present report) the stream has a fall of 49.8 feet. In the lower 215 miles of its course the fall is only 25.2 feet. So low is the gradient of the lower course, that in the Mississippi at Grafton have been reported floods higher than low-water level at Utica, more than 240 miles up the valley.[2] The lower valley is eminently useful as a waterway, but entirely unsuited to the development of power; the upper valley is capable of a very considerable development of power, but in its natural condition is unfit for navigation.

[2]Collected from Cooley, L. E., Lakes-Gulf Waterway.

### VOLUME OF WATER

In its unimproved condition the flow of Illinois River was so irregular that in former years it became a reeking slough in seasons of drought, and in flood-time discharged occasionally a volume of water forty times that of its normal flow. Extreme low water has been reported at Morris, as from 250 to 350 second-feet (cubic feet per second); and at La Salle 633 second-feet have been measured. The bank-full capacity at La Salle is about 20,000 second-feet. Periods of extreme drought formerly caused the river to dwindle to a mere ribbon of water within its banks. Once or twice within a decade a maximum of 60,000 to 67,000 feet is reached, or about three times the bank-full capacity of the stream, and about 120 times the average minimum.[3]

The average flow of the stream in its various parts is given in Table 2.

TABLE 2.—*Average flow of Illinois River in its various parts given in second-feet*

| Gauge station | Average low water (for three driest months) | Ordinary | Average high water (for three wettest months) |
|---|---|---|---|
| Head of Illinois..... | 444 | 1,577 | 8,424 |
| Mouth of Fox River. | 697 | 2,369 | 13,180 |
| Mouth of Vermilion.. | 796 | 2,820 | 15,066 |
| Mouth of Illinois.... | 1,904 | 6,747 | 36,045[a] |

[a]Record kept from 1890-1899. Water from drainage canal is not included in these figures. Water Supply and Irrigation Paper 194, p. 159.

These great fluctuations of volume are due to: (1) The character of the precipitation, which is irregularly distributed through the year and varies greatly from year to year. (2) Temperature conditions permit snow to accumulate through the winter far beyond the amount of precipitation from any single rain. The snow may melt rapidly in the spring, and the run-off, flowing over the still frozen ground, may flood the valleys suddenly. The spring ''break-up'' is directly responsible for many floods. Kankakee River, for instance, has a habit of thawing out before the ice moves at Morris, and ice-jams result which flood the lowlands about this city. (3) The character of the soil aids floods. The soil is largely clayey and quite impervious; hence much water runs off, and little sinks in. Observations made on the precipitation show that the greater part of the water reaches the streams by rapid run-off and not by gradual seepage. With the exception of the Morris basin, the slopes of the Illinois and the sides of the tributaries are steep and aid run-off. (4) In the cultivation

[3]Report of Internal Improvement Commission of Illinois, p. 23. In Claypool's record at Morris, kept for 56 years, it is shown that during 20 years the river was not out of its banks; in the other 36 years there were 53 floods; the time out of banks averaged 9 days. The greatest recorded flood occurred in 1892; the flood was gauged at Morris as 73,730 feet; at La Salle-Peru as 93,600 feet. See also Cooley, L. E., Lakes-Gulf Waterway, pp. 49-51.

of the land, much of the timber and most of the original soil cover of grasses have been destroyed. Plowed fields with their well-spaced crops present no such check to the rapid run-off of water, as did the forest cover and the matted turf of the original prairie.

The floods still come as they did formerly, but periods of low water are no longer seen on the Illinois in their former extremes. The Chicago Ship and Drainage Canal now constantly discharges water from Lake Michigan into the Illinois. In periods of normal or high water this volume is not very noticeable; but at low-water stage it makes up a great part of the volume of water flowing down the upper valley. The river, which formerly at low water became fouled with the sewage of the upper river towns and was seriously impaired in the use of its water-power, "is now

FIG. 4.—Lovers' Leap, looking up Illinois Valley from Starved Rock.

a comparatively clear stream to which fish have returned," no longer a menace to public health, and much more valuable for power purposes than formerly.

## Surface Features of Upper Illinois Valley

### VALLEY SIDES

Scenic effects for the most part are not diversified nor grandly massed in the prairies of Illinois. To this statement the upper Illinois Valley with its varied relief presents an agreeable exception. At its head, the Minooka ridge rises northward, whereas to the south and west a broad, low plain stretches halfway around the horizon. This is the Morris-Kankakee plain, a basin which includes most of Grundy County. The river here flows upon the prairie and has no well-marked banks. At Seneca the river begins to sink beneath the prairie, and valley walls become well-defined. The slopes at first are low and gentle, and are farmed or used for pasturage. Downstream, the valley sides steepen and become higher; pastures and fields give way to woods or brush-covered slopes. At Marseilles the valley sides are almost 200 feet high and have become well-defined bluffs. Below Ottawa they become sheer walls, with bare rock faces, most pronounced between Ottawa and the mouths of the two Vermilion rivers. Between La Salle and the "Great Bend" the slopes are again gentler, and narrow. discontinuous benches appear upon them here and there.

In the valley are several large masses of rock which have become detached from the bluffs by erosion. The most conspicuous of these are Buffalo Rock, Starved Rock, and Lovers' Leap (fig. 4) between Ottawa and Utica. These are isolated bodies of sandstone, that rise like towering fortresses above the valley floor.

### VALLEY FLOOR

The width of the valley is quite uniformly one and one-half miles, but the surface of the valley floor varies much from place to place. A true flood plain with broad alluvial bottoms and sloughs has been developed only below Utica.

In the Morris basin is much low land which is often flooded. From 10 to 20 feet above the flood plain of the Morris region lie the second bottoms, which are low extensive terraces. The land marginal to the river about Morris is not as desirable as the second bottoms and other lands more distant from the stream, partly because much of the riverward portion is subject to overflow, and partly because much of it is too sandy for the best growth of anything but truck crops. Below the Morris basin and above the mouths of the Vermilion rivers the valley floor consists in the main of a terrace about 40 feet above the narrow channel. About Seneca this terrace is level and covered with a deep soil, well suited to agriculture. Between this point and Utica the floor of the valley is in general irregular, and exposes at numerous places bare rock surfaces. Here is rarely more than a thin veneer of sand or silt above bed rock, and because of the scant soil, most of this part of the valley is not cultivated and is commonly used for pasturage. Occasionally small alluvial fields of high fertility lie beside stony pastures, where the meager soil can scarcely sustain even the grasses against the summer heat. Below Utica the typical alluvial river bottoms reappear. The soil is deep and fertile, but subject to floods and poorly drained, and in its unimproved condition unfit for agriculture in many places. Here we find most of the land given over to the wild growth of swampy bottoms—sycamores, willows, and reeds.

PRAIRIE

Beyond the bluffs the prairie begins. As viewed from the valley, the bluff line lies smooth and straight against the sky except for occasional notches made by tributary streams. Viewed from the prairie the valley appears merely as a gash in the generally flat surface. In reality the bluffs are joined to the upland behind them by a gentle, partially wooded slope which rises 20 to 40 feet in a quarter of a mile or less. The prairie at its riverward margin is 160 to 200 feet above the river level in most places; away from the valley it rises gently another 50 to 200 feet. Figure 5 shows a profile across the valley at Ottawa and illustrates the general topographic relations for the region.

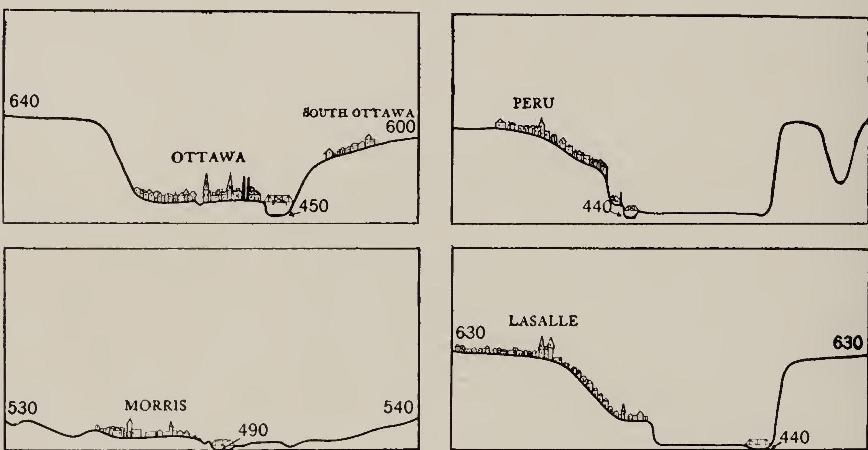


FIG. 5.—Cross-sections of Illinois Valley at Ottawa, Peru, Morris, and La Salle showing relation of cities to physiographic features. Numerals represent elevations above sea level.

The prairie of La Salle and Bureau counties is typical of northern Illinois. It has a slightly undulating surface, lacking in the ponds and swamps of the country farther north, yet almost unfurrowed by valleys. A few broad ridges interrupt the generally smooth surface: (1) at Princeton; (2) the Farm Ridge south of Utica; (3) most prominent of all, the Marseilles moraine, part of which is known as the Rutland Hills; and (4) the Minooka ridge. These ridges are roughly parallel to one another, and are at right angles to the river valley. Because of their gentle slopes, they are more conspicuous from a distance than nearby.

This is part of the best agricultural section of the Middle West—the famed region of prairie farms—in which the upper Illinois country equals any section of this or adjacent states. Almost every foot of ground is cultivated here, and the prospect is one of highly developed farms, because of the broad fields, straight roads that run with the cardinal directions, and scattered farmhouses with well-appointed farm buildings grouped about them. These fill the body of the scene, and against the distant horizon may stand a thin line of trees that marks the course of some prairie stream. This is the home of the prairie farmer, one of the finest of American types.

### TRIBUTARY VALLEYS

The character of the drainage of this region is in striking contrast with that of southern Illinois or the Wisconsin border. Compared with the former the drainage is less well developed; there are fewer streams, and these are shorter and have fewer tributaries. Northward, drainage lines are more poorly developed than in this region; streams follow depressions which they have not made, and undrained areas occupied by swamps or ponds become common.

The local area is fairly well supplied with surface drainage. Below La Salle the tributary valleys are very wide for the size of the streams that flow through them, and rock outcrops are few. Spring Creek is an example of this type. Between La Salle and Ottawa the tributaries are cut in rock, and have developed canyons that are striking for their scenic beauty. Both the Vermilion river valleys are tortuous chasms in their lower courses and show picturesque rapids and overhanging rock walls. It is about the lower Vermilion Valley and about Starved Rock that scenic attractions are centered especially. Here each turn discloses new scenes of nature's beauty—canyons crowned by a fringe of cedar and pine with a glimpse of blue sky between, bold cliffs of rock that bathe their feet in shining pools, and companies of forest trees encamped around a noisy waterfall. The general effect is one of beauty, almost of grandeur, a sight unlooked for in its impressiveness in a prairie region.

At Ottawa, the tributary valleys again grow wider and the slopes less steep. Fox River valley, which joins the Illinois at Ottawa, has rather gently sloping sides, but almost no flood plain. It is much interrupted by rapids and was once made to drive numerous mills.

The upper tributaries of the Illinois show a great variety of conditions. Mazon Creek is in its lower course a widely meandering stream with alluvial banks; its middle course is marked by rapids and rock walls; and the headwaters again are sluggish and shallow prairie streams. The Au Sable is alternately rapid and sluggish, stretches of fairly rapid flow succeeding stagnant pools that are overgrown by water weeds and are the home of waterfowl.

## Relation of Topography to Occupations of Man

The various surface features—the flat upland, the steep-sided valleys, the alluvial bottoms—have affected the development of the region by man. The surface has either invited or retarded the growth of population, according to the possibilities of its cultivation, the accessibility of its mineral resources, its transportation facilities, and the character of its drainage.

### CONCENTRATION OF POPULATION IN ILLINOIS VALLEY

Comprising only a small part of the area under consideration, the immediate valley of the Illinois has attracted a greater population than has any similar area in this part of the State. Every important city of this region lies within the valley. The rural population, however, is less dense in the valley than upon the prairie, because of the low lying and ill-drained, or the uneven and infertile bottoms. Towns have sprung up in the valley (1) because Illinois River served as the first highroad by which settlers moved into this country, and upon which their early commerce was carried; (2) the first transportation line built, the Illinois and Michigan Canal, followed Illinois Valley because it is the lowest line leading west from Lake Michigan; (3) an early railroad chose the valley of the Illinois for its route, partly because a number of settlements had become established there, but principally to avoid bridging the numerous deep tributary valleys which dissect the upland. The valley still possesses transportation facilities which are superior to those of the adjacent prairie regions.

Chiefly by these superior advantages of the valley for transportation, is the growth of its urban population to be explained. A secondary reason is found in the accessibility of its mineral resources. The principal exposures of bed rock and its mineral wealth are in the valley bluffs. It was along the valley that the first development of coal mining took place, and it is here that exploitation of mineral resources is most extensive today.

### INFLUENCE OF THE SURFACE ON DEVELOPMENT OF TRANSPORTATION LINES

The number and direction of transportation lines have been determined chiefly by the character of the surface. Within the area under consideration Illinois Valley presents the easiest line to follow, and it is at the same time the most difficult belt to cross, since it is 150 to 200 feet below the general level of the upland and more than a mile in width. It is therefore an obstacle to communication between the uplands on opposite sides of the Illinois. Roads, both rail and wagon, enter the valley by following tributary valleys, thus reducing the grade of their descent. The North Western and Burlington railroads enter Illinois Valley by way of

Spring Creek, and the Illinois Central and Burlington similarly cross by way of the two Vermilion rivers. The wagon roads that converge at Marseilles lead down from prairie to river by following various tributary valleys about Marseilles.

On the upland, movement becomes increasingly easier away from Illinois Valley, since the tributary valleys become shallower headward and cease to present serious obstructions to transportation. Upon the level prairie, movement is equally easy in all directions. The wagon trails of the pioneers ran in straight lines from settlement to settlement. One of these led from Ottawa diagonally across to Vermilionville; another struck southeast toward Danville, and because of its straightness became known as the "Danville Air-Line." The best known of all of these pioneer roads, the "Chicago Road," was worn deep in early days by the trains of ox wagons which sought a market in the distant lake port. This road runs northeastward from Ottawa through Danway. Of these old roads, remnants only are left. The surveyor came soon after the settler and laid out roads by the compass. The old diagonal roads were abandoned for the most part, and the new ones conformed largely to the network of squares laid out by the surveyor. Only those diagonal roads which had become most firmly established as short cuts between settlements have been suffered to remain.

In the valleys the roads could not be laid out on section lines, and here they are controlled by the character of the relief. A map of the roads of this region gives some idea of the character of its topography—on the prairie, a rectangular system of roads; in the valleys, irregular roads controlled by the direction of the drainage.

## LOCATION OF TOWNS

The exact location of villages within the valley of the Illinois was determined largely by terraces which furnished room enough for settlement, gave easy access to both river and prairie, and were out of harm's way during floods. Below the mouths of the Vermilion rivers the terraces of the Illinois are discontinuous, and small, so that favorable sites are not numerous in the western part of the valley. Depue, Peru, and La Salle are examples of settlements located on terrace remnants. Between Utica and Morris the broad, high terraces furnished abundant room for settlements. In the Morris basin the lowlands are extensive, and the city of Morris was located in consequence on a terrace which affords reasonable security from flood damages (fig. 5.)

The growth as well as the location of the river towns has been influenced by the relations of river floor, terrace, valley side, and upland. Marseilles, dependent upon the rapids of the Illinois, and located north of the river because of canal and rail shipping facilities, had only a narrow strip of land north of the river available for its expansion and accordingly grew to be two miles long and only two streets wide. Several ravines that come into the valley at Marseilles made it possible for roads to ascend to the upland, and here the newer part of the city has been built. At La Salle and Peru the river has left above its broad alluvial floor a prominent terrace remnant about 60 feet above the stream. At La Salle, the terrace is broader, and the back slope gentler than at Peru; and the past greater growth of La Salle has been due, in part, to the greater amount of available room. Both towns have long since outgrown the limited area of the river terrace, overspread the valley slope, and reached the prairie beyond. At present, with the expansion of both towns on the upland, the only advantage of surface left to La Salle is the gentler slope connecting the upper with the lower town. In both cases the broad, low, alluvial bottom precluded the growth to the southern side of the valley, as was the case at Ottawa, and as may be the case at Marseilles. In La Salle, First and Second streets occupy the terrace flat. Back of Second Street is a rise of 70 to 80 feet to Fifth Street. Beyond Fifth Street the city lies upon the prairie. A similar condition prevails at Peru. Thus it happened that as these cities outgrew their terraces the people living in the newer or prairie section found their dependence upon the valley section inconvenient. To the older, lower business district there was added a second business district on the hill which avoided the difficulties of the intervening slope. In Peru the upper business section has passed the lower in importance, because it serves the majority of the city's population. Figure 5 shows cross-sections for the cities of Peru, La Salle, Ottawa, and Morris, and represents graphically the conditions of surface which, in different ways, have influenced the conditions of growth of these places.

In building on the slopes of Illinois Valley, artificial terracing has been resorted to extensively. The houses front chiefly on roads that parallel the strike of the slope. Because the lots above the road have a more commanding position than those below, the more expensive residences have been built on terraces above the road, and humbler houses on the unterraced side below the road.

Because bared hillsides wash readily, the care of the roads early became a necessity, and excellent macadamized and paved streets are the rule in these river towns.

## RELATION OF TOPOGRAPHY TO UTILIZATION OF LAND

A great advantage of the Prairie States for agriculture lies in their surface, the greater part of which is sufficiently flat for cultivation, and for the use of machinery in the production of crops. In the prairie townships of this region, almost every foot of ground may be cultivated.

Farm Ridge and Miller townships in La Salle County, for example, are made up almost entirely of cultivated fields.

Near Illinois Valley, the surface is not so favorable for agriculture. Because the river is depressed more than 150 feet below the level of the prairie, the riverward margin of the upland has become dissected by numerous tributaries. These tributary valleys, as well as the Illinois, have slopes in general too steep for cultivation, except in the Morris basin. On both sides of Illinois Valley, therefore, is a belt of timbered land or of pasture, varying from one-fourth to one-half mile or more in width. Correspondingly narrower belts flank the tributaries. Beyond the immediate valley slopes, however, the upland is nearly flat, so that cultivation on the upland may extend to the margins of the valleys. In the region of Starved Rock with its box-like valleys, the prairie fields run in many places almost to the brinks of the canyons.

As the valleys grow shallower headward, the amount of waste land decreases, so that the upper third of many valleys consists of cultivated fields or of meadows. During the growing season, some of these "draws" on the prairie are more readily discovered on the map than in the field, as even a stand of tall corn may obscure the shallow depression. The larger stream lines may be accurately followed by noting the lines of trees that almost invariably follow them. Practically the only timber left in the region is in the valleys, and they fill accordingly an important position in the agricultural economy of the prairie.[4] The larger tributaries furnish in some cases limited areas of farming land on the alluvial flats of their lower courses, but their chief uses are for pasturage and for timber supply.

In the valley of the Illinois is considerable low-lying land which is either marshy or subject to flood and has not been cultivated. The most of these first (lowest) bottoms lie below Utica and about Morris. The quality of the land is excellent, and its only drawback is its lack of drainage. It may be expected confidently that its reclamation will take place within a brief period and will add an important class of lands to those already farmed.

## EFFECT OF TOPOGRAPHY ON ECONOMIC AND SOCIAL CONDITIONS

The character of the surface affects the culture and prosperity of the region in many ways, chiefly through the conditions of communication and of agriculture. The prairie farmer (1) can put practically his entire farm under the plow and make all his land productive, and (2) has had the drudgery of farming reduced to a minimum because he is able to use machinery extensively. The hill farmer, on the other hand, (1) can clear

[4]The timbered slopes of the valleys are of course less valuable than the flat surface of the prairie. Agriculturally, therefore, those townships are most desirable which lie far enough from the river to have a minimum of dissected surface. In Farm Ridge township, the farms were said in 1910 to be worth, on an average, $200 per acre, whereas the more "broken" land marginal to the valley of the Illinois sold for $125 to $150, and the land which was all in timber for $50 to $75.

only part of his land; (2) fields are small and uneven, so that much hand labor is required in the production of his crops; and (3) the soil is poorer than on the prairie and needs more care in cultivation, so that slope wash may not remove the rich surface materials. The hill farmer must work harder than his neighbor of the prairie for smaller returns. Prosperity thus avoids the timbered fringe of the valleys and keeps to the open prairie. The uneven surface imposes a handicap upon the hill farmer in the marketing of his products as well as in their production; he begins with a harder row to hoe, and ends with a harder road to travel to market.

Socially an equally great advantage lies with the prairie farmer. It requires less time for him to do an equal amount of work than it does the hill farmer. Consequently he has more leisure than the latter for social purposes. His neighbors are also nearer and easier to reach because of better roads. As a result the prairie farmer develops by social contact, whereas the other too frequently retrogrades in his isolation. The lot of the average farmer in this region is excellent both as regards his farm labors and his social opportunities. But even in this area, examples can be found of this difference in condition, illustrated most strikingly by the highly developed prairie farms of Vermilion Township, contrasted with the isolated backward farms which are tucked away in the bends of the chasm-like Big Vermilion River.

# CHAPTER III—DESCRIPTION AND HISTORY OF THE HARD ROCKS

## Classes of Sedimentary Rocks and Their Origin

### GENERAL PROCESSES

Bedded rocks or "rock ledges" may be seen along almost every valley in this region and offer abundant opportunities for studying geologic history. Well records and mine shafts furnish additional information concerning the materials underground. The local geologic record is of particular interest, both because it shows a diversity of geologic history which cannot be duplicated in the State, and because the life of the people of this section is bound up most intimately with its mineral resources.

The geologic history is such that, with a little help, anyone who will may read it in the characteristics of the formations of the bed rock and their relations to each other. The simple fundamental idea is, that these bedded rocks are deposits of sediment, such as mud or sand, which formed a very long time ago, on land or under water became buried by other deposits and were slowly hardened into rock. The change of many of these rocks from their original condition has not been great, and the origin of the formations may still be seen clearly. There is no reason to believe that the processes of the geologic past differed greatly from those now in operation at the surface of the earth. Streams, waves, and winds were then at work as at present. It is necessary merely to remember that the scene of activity of the various geologic processes has been shifted from time to time. Where now there are farming lands there once may have been a shallow sea, and waves shifted about the sand which now appears in the sandstone of the valley sides.

Wind, water, and ice have acted at various times as agents of deposition in this region, but of these water has been by far the most important in the geologic record. The work of water has consisted partly in dissolving and redepositing rock matter, but more largely in the mechanical transportation of sand and mud. By depositing these materials in large quantities water has been responsible chiefly in the formation of clastic sediments, the most common class of sedimentary rock.

### MECHANICAL OR CLASTIC SEDIMENTARY ROCKS

Most of the rocks composed of mechanical or clastic sediments were formed by shore or stream deposition. The size of the materials which water may handle depends upon the vigor of its movement. The upper part of a stream has, as a rule, the most rapid flow. Here the transporting power is generally great, sand and silt are carried easily by the swift current, and gravel only is lodged in the stream bed. Even large stones at the bottom are subjected to vigorous wear by the incessant pounding of rock fragments upon them, and in time may be so reduced in size that they may be rolled along by the current. Downstream the velocity gradually lessens, and the stream's ability to carry coarse material is decreased correspondingly. It is thus forced to drop successively finer and finer sediments, first gravel, then sand, and lastly silt. In its lower course it may be able to handle only fine sand and mud, alternately depositing and removing them as the current varies in strength or amount of load. Some of the mud may be carried out to sea and built into deltas.

Similarly *shore deposits* vary according to the strength of the waves which formed them. Where the waves break in shallow water, and especially where they dash against the shore, gravel and sand may be the most abundant materials. With increasing depth of water the waves agitate the bottom of the water less and less, and finer sediment is shifted about. From the shore outward the sediments commonly grade from gravel along the beach, to fine mud in the deep water.

These sediments have formed three general sorts of sedimentary rock, which are based on contrasts of texture.

1. The mud deposited by ancient streams or seas may have changed only slightly and is called *clay*. If it has been compressed and cemented it becomes *shale*. Under great pressure, shale may be converted into *slate,* which cleaves into thin sheets like roofing slate.

2. *Sandstone* is cemented sand. If the water which circulates through the pores in the sand carries dissolved mineral matter and deposits it between the grains, the individual grains become cemented and sandstone is formed. If silica (the substance of sand itself) forms the cement, a hard and durable sandstone or quartzite is the result. A cement of a lime or other carbonate, on the other hand, is easily redissolved, and a sandstone with such a cement weathers rapidly on exposure.

3. *Conglomerate* is the rock equivalent of gravel. It too may vary greatly in compactness and in its resistance to weathering, according to the kind of gravel from which it was formed and the degree of pressure and the kind of cementation to which it has been subjected. The distribution of conglomerate is generally much more limited than that of the other clastic sediments because gravel is deposited less generally than either sand or mud.

Shales and sandstones abound in this region; conglomerate on the other hand is rare.

## ORGANIC SEDIMENTARY ROCKS

In rocks of organic origin, the agency of plants or animals or both is essential.

### LIMESTONE

In the sea water is a vast number of animals, largely shell fish, which secrete lime carbonate. When they die their remains, consisting largely of lime carbonate, may sink to the bottom and there accumulate in large beds. These beds may be hardened into limestone. There are other ways in which limestone is formed, but this is the most common. A pure limestone signifies ordinarily a clear sea as the place of its origin. If the limestone is clayey, the floor of the sea in which it accumulated was muddied by the inflow of streams or by the drag of waves.

### COAL

That coal is derived from plant remains is evident to anyone who has observed the imprints of leaves, the portions of stems, the woody fiber, and even the roots common in soft coal. The beginning of the story of coal may be read from almost any swamp or bog. A body of quiet water is required, into which little or no sand or mud is washed, and which is shallow enough for the growth of plants. The seeds and dead leaves and stems drop into the water which soon acquires preservative qualities that arrest decay. By the continued accumulation and partial preservation under water of plant matter, peat is formed, the first step in the formation of coal. The next step takes place by the burial of the peat beneath sediments.

But coal is more than compressed vegetable matter, for the vegetable tissues have suffered chemical changes. The overlying sediments exert pressure and shut off the free access of air and water. As a result, chemical changes take place which cause the buried vegetation to give off gases that are combinations of oxygen, hydrogen, and carbon, the principal constituents of organic matter. More oxygen and hydrogen are given off than is carbon, so that the percentage of remaining carbon increases with time. This concentration of carbon gives coal its high fuel value.[1] Compression and loss by chemical change are so great in the formation of coal that the vegetable growth of at least 3,000 to 4,000 years is estimated as required to afford material for one foot of coal.[2]

Both coal and limestone are of wide distribution in this region.

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[1]The process of burning consists in the combination of oxygen from the air with the carbon of the fuel.

[2]Ashley, Geo. H., Economic Geology, vol. 2, p. 47.

## SPECIAL FEATURES OF ROCKS

Certain special features may be mentioned which are not peculiar to any one kind of local rock and which occur prominently in several formations of the region.

### VEINS

Some of the limestones along the Vermilion River, particularly at Oglesby, show irregular bands or *veins* of white crystals (calcite) that run at various angles to the beds or bedding planes of the rock. These veins are generally short, and many of them are not connected. The St. Peter sandstone at Dayton affords a striking example of vein fillings: The river floor at that place has a peculiarly honeycombed appearance, caused by

Fig. 6.—Honeycombed bed of Fox River at Dayton. The knife-like ridges are resistant veins in the St. Peter sandstone.

knife-like ridges in the rock which intersect each other variously (fig. 6). These ridges are caused by veins of harder material in the softer sandstone, exposed through stream erosion.

Veins are the filling of cracks in rock. Due to some strain, a rock develops cracks in which the circulating underground water deposits some of its dissolved mineral material. Ordinarily, ground water circulating in a limestone formation fills these crevices with calcium carbonate, which crystallizes into calcite; in sandstone the veins are commonly of silica and very resistant to weathering, as shown by the small ridges in the St. Peter sandstone.

### CONCRETIONS

Concretions are to be seen in widely varying forms in practically every formation, from the oldest bed rock, the limestone of the upper Prairie du Chien group (Lower Magnesian) at Utica to the post-glacial clays found along the Illinois Valley. Figure 7 shows concretions which have weathered out in the bed of the Au Sable Creek, immediately above the aqueduct. The rock in which they occur is a sandstone containing many shining flakes of mica; the concretions consist of a groundmass of plates of calcite in which are set grains of sand and plates of mica. In these concretions the materials of the sandstone have been replaced largely by calcium carbonate (calcite). They range from a spherical to a flattened, disc-shaped form, and occasionally are twin growths.

Some of the most famous concretions of the country are from Mazon Creek. They are flattened, elliptical bodies of a hard iron-bearing shale, imbedded in a soft clay shale. The nucleus about which these concretions formed, consists of parts of plants or animals that chanced to be buried in the Carboniferous mud. Fern leaves or bits of bark are the most common nuclei, but occasionally insects, small fishes, and other material have had these concretionary forms cased about them. The perfection of their preservation, to the minutest and most delicate detail, is marvelous. The shape of the nodules corresponds somewhat to the form of the enclosed leaf or animal.

In chemical composition, concretions are commonly unlike the formation in which they are found: The Prairie du Chien limestone carries concretions of silica (chert); in the St. Peter sandstone, the concretions are composed of iron compounds (largely pyrite or iron oxides); "ironstones" are most common in the "Coal Measures" clays, and pyrite in coal; the concretions in the Carboniferous sandstones are mostly calcium carbonate.

Concretions are formed after the deposition of the material in which they are imbedded, chiefly by the action of ground water, which by selective solution and deposition of the minor constituents of a formation tends to segregate these "impurities." About a convenient nucleus the circulating waters deposit a film of some mineral, continuing the process and building ever larger concentric layers about the older films, until a concretion is developed. This process may go on until the most of a minor mineral of a formation is extracted from the main mass, and assembled in these concretions.

Fig. 7.—Views on Au Sable Creek above the aqueduct of the Illinois and Michigan Canal. The bed of the creek is here covered with disc-shaped and spherical concretions originally contained in the soft Carboniferous sandstone and left behind when stream erosion removed the sandstone

## Hard Rocks of Illinois Valley

### UNEXPOSED ROCKS

By erosion and deposition continued through many millions of years the earth has become mantled generally with sediments of great variety, which are disposed in rather orderly succession, and record within themselves the past history of the region. The oldest formation definitely known to exist beneath this region is not exposed at the surface within the limits of the State. Its presence is known through deep-well drillings only. By this method it has been located in the eastern portion of the upper Illinois Valley where the rock formations lie at a higher elevation than farther west. Hence the older and deeper-lying formations are more easily reached by borings at the east than at the west. This completely buried formation is the Potsdam sandstone. It has been located at Ottawa, at a depth of about 1,100 feet. The rock is porous and carries a great amount of water. It comes to the surface in central Wisconsin and is a prolific source of water for many deep wells in the southeastern part of that State, as well as in northeastern Illinois.

### EXPOSED ROCKS

#### PRAIRIE DU CHIEN GROUP

The Prairie du Chien group (formerly known as the "Lower Magnesian" limestone) comprises the oldest formation which appears at the surface in Illinois. Its largest area of outcrop is in this region, distributed in three principal localities (Pl. II). The thickness of this formation is several hundred feet.

The most extensive of these is a belt about two and a half miles wide between Utica and Split Rock. Its eastern limit coincides with the eastern limit of the village of Utica. Westward it rises to the prairie beyond the northern bluff of the valley. Southward it crosses the river a short distance below the Utica bridge. Along the lower Pecumsaugan Creek it outcrops rather extensively on the upland. A few hundred feet east of Split Rock, the formation dips beneath the St. Peter sandstone, and disappears under the floor of the valley.

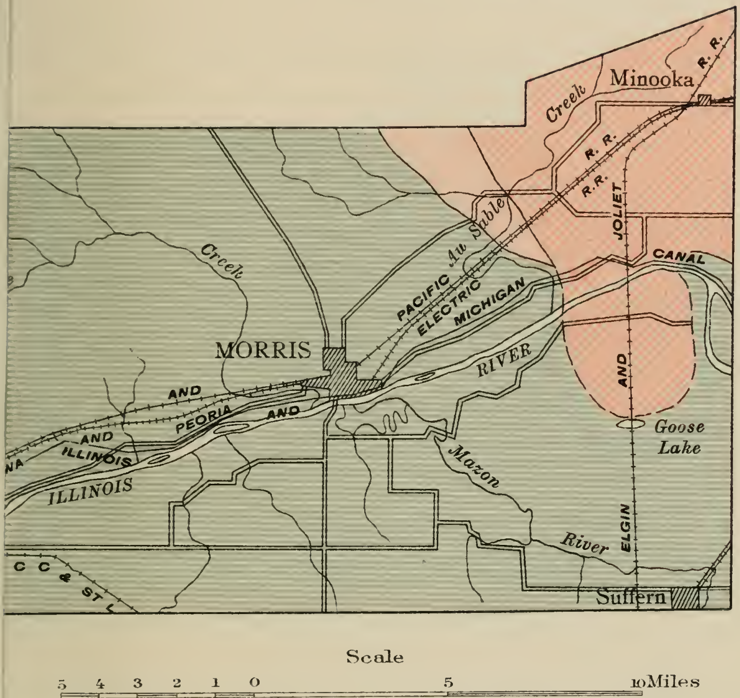
The second outcrop is on Tomahawk Creek, a tributary of the Little Vermilion River. This outcrop is intersected by the road which crosses the creek half a mile north of Mitchel School. It is confined almost entirely to the floor and sides of the valley and is exposed for a distance of slightly more than half a mile. A similar outcrop occurs on Little Vermilion River northwest of the one mentioned above. These three outcrops form a straight line running somewhat west of north to east of south.

The Prairie du Chien is one of the great limestone formations of the Middle West. It is well known locally because of its beds of hydraulic-cement rock. It is not common limestone (calcium carbonate), but a magnesian limestone (calcium magnesium carbonate) called *dolomite.* Dolomites are harder and more resistant to weathering than true limestones. A little clay is present very generally in the Prairie du Chien limestone as an impurity, and here and there is also some sand. In its upper part the formation contains thin beds of quite pure sand, alternating with beds of limestone which have little or no sand. In its lower exposed parts sand is almost absent, and the formation consists of massive dolomite, either clayey or pure. The color of the limestone in fresh exposures is a dull

FIG. 8.—Quarry in St. Peter sandstone near Twin Bluffs.

drab. Weathered surfaces have a slightly buff color on account of the iron which has been oxidized where the stone has been exposed to the air. The presence of iron in any formation is, as a rule, readily betrayed by weathering, as iron compounds soon oxidize (rust) and become brownish yellow.

The Prairie du Chien limestone is characterized by a lack of persistent qualities. Variations of mineral composition are shown by the very irregular surface which the dolomite develops on weathering, due to the unequal solubility of its various parts. It is variously thick and thin bedded; some beds may be a dozen feet thick, others are mere laminae a dozen of which may not exceed a foot in thickness. Where rather pure,




A. HOEN & CO BALTIMORE, MD

Prairie du Chien group
(Lower Magnesian formation)

(*Massive magnesian limestone carrying a little clay and sand as impurities; in the upper part distinct thin beds of sand are present*)

it is finely crystalline in texture, but this quality disappears with an increase of clay. One of its most striking features is its beds of concretionary *chert,* which is siliceous matter, akin to flint. The formation is highly concretionary, and most of the concretions are segregated into rather distinct layers. Many of the cherts are 8 to 12 inches in diameter and if broken through, show beautiful banding due to concentric deposition.

FIG. 9.—Tributary canyon in Deer Park Glen. This small canyon, like the larger ones about it, is cut in St. Peter sandstone. It shows the unequal erosion of the sandstone, and in its caldron the light streaks indicate the deposition of soluble salts, chiefly magnesium and calcium carbonate, leached from the cement of the sandstone.

ST. PETER SANDSTONE

Next in the geological series is the nonfossiliferous St. Peter sandstone, which lies above the Prairie du Chien limestone and ranges from 140 to 200 feet in thickness. Its area of surface exposures within the State is almost as small as that of the preceding formation, and most of its outcrops are disposed marginally about the outcrops of the older formation. In this region the western limit is Split Rock, two and a half miles east of

La Salle, and thence it extends across to a similar point on the south side of the valley. South of the river the outcrop does not rise above the bluff line. Northward it occurs as the surface formation beneath the upland prairie from Little Vermilion River eastward to Clark's Run. East of Utica its surface declines rapidly. In Ottawa it is slightly above the level of the canal, and a mile and a half to the east it dips beneath the floor of the valley. In the Fox Valley the formation is exposed at the surface, with slight interruptions, far beyond the area covered by this report. A small isolated outcrop has been exposed in Deer Park Glen.

The St. Peter sandstone is characterized by a striking uniformity of qualities. It is throughout a sandstone of unusual purity. The well-rounded sand grains are fine, generally of dazzling whiteness in fresh exposures, and almost without admixture of clay, the absence of which makes it valuable for the manufacture of glass. Cementation has commonly been slight so that the freshly exposed sandstone may be freely worked with pick and shovel. Figure 8 shows a characteristic exposure of the sandstone with accumulations of loose sand at the base of the pit. The cementing material is most commonly silica; but in places a little iron oxide, and more rarely calcium-magnesium carbonate, is present. Figure 9 shows white stains in the caldron at the base of the falls. This is mostly silica and calcium magnesium carbonate which has been leached out of the cement of the sandstone. Locally there are distinct veins of the sandstone, and in veins a little sand is included. The veins are of quartz, and where the sand is included in them the vein looks something like quartzite. On Lower Buck Creek above Wedron an unusual and beautiful form of cementation may be seen. The sand is here cemented by iron sulphide (pyrite), and the blue-gray quartz grains set in the glinting gold-colored pyrite flash like precious gems. The water which comes from the St. Peter sandstone is heavily charged with sulphureted hydrogen from the decomposition of the pyrite. A well penetrating to this sandstone may be recognized almost unmistakably by the sulphurous taste of its water. Concretions, although rather common, are inconspicuous. They generally contain more iron oxide than the body of the rock, and by reason of their superior resistance and darker color, they are conspicuous on weathered surfaces as irregular reddish-brown knobs. They may be seen on Starved Rock.

On Tomahawk Creek the contact between the Prairie du Chien limestone and the overlying St. Peter sandstone (fig. 10) shows: (1) that with uniformly dipping beds the line of contact between the two formations varies considerably and irregularly in elevation. (2) On close examination of the surface the contact shows an irregular line separating the two formations; at one place this line departs from the dip 9 inches vertically within a horizontal distance of two feet. (3) At the contact may be observed in places loose cherts and blue, noncalcareous clay, the products of long weathering. (4) The two formations are quite distinct at the plane of contact; the Prairie du Chien below is typical dolomite; the St. Peter above as typical a sandstone. There is no gradation. The phenomena mentioned under (1), (2), and (3) record an interruption in the process of sedimentation, known as *unconformity,* and the fourth point is consistent with the other three. The general relation is shown by figure 10; a conformable relation is shown in figure 12. In the conformable relationship, the change from the deposition of one kind of sediment to

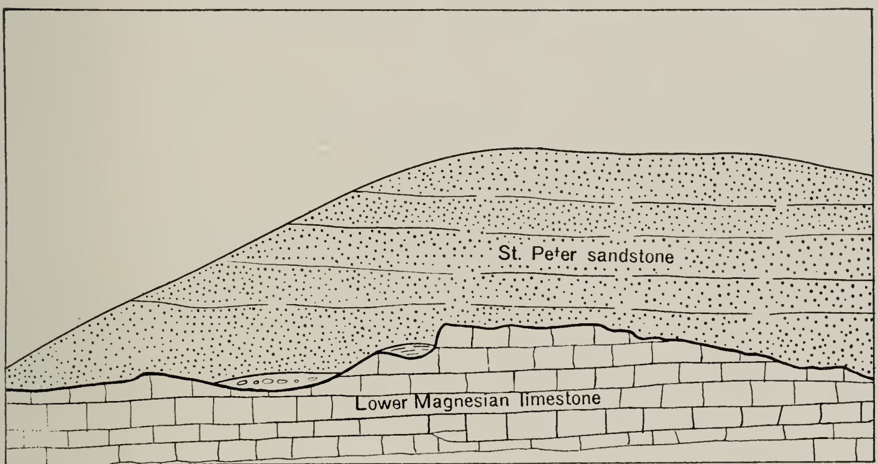



FIG. 10.—Diagrammatic illustration of the unconformable relations of the Prairie du Chien ("Lower Magnesian") limestone and the St. Peter sandstone.

another was gradual, and there was no break in sedimentation. The unconformable relationship indicates that after deposition of the older formation sedimentation was stopped, the surface was eroded, and the products of weathering accumulated before later beds were deposited upon the older formation. Similar evidence of an unconformity between the Prairie du Chien and the St. Peter may be secured in abundance along Illinois Valley, particularly in the second ravine east of Split Rock.

## PLATTEVILLE-GALENA LIMESTONE

The Platteville-Galena limestone (formerly called the "Trenton-Galena" limestone) is a general name used for the Middle Ordovician limestone which includes both the Galena (now correlated exactly with the Trenton proper) and the somewhat older Platteville limestone.

The distribution of this formation, for causes to be noted later, is irregular. Many of the outcrops are too small to be shown on the sketch map (Pl. II). The three principal districts where this formation outcrops in this region are (1) along the line of the Vermilion rivers, notably at Deer Park and on the Little Vermilion about Troy Grove; (2) in the vicinity of Ottawa, including a broad outcrop on the valley floor west of Ottawa, and a narrow area occupying the valley of lower Covel Creek; and (3) an obscurely defined area east of Morris on Au Sable Creek.

The thickness of the formation is more variable than that of any other formation exposed in this region. Over a considerable part of the area

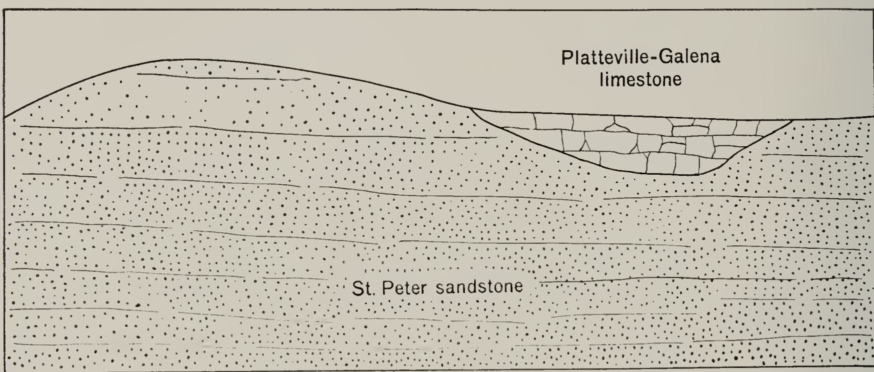



FIG. 11.—Diagrammatic illustration of the unconformable relation between the St. Peter sandstone and Platteville-Galena ("Trenton") limestone.

underlain by formations younger than St. Peter sandstone, it is wanting entirely, whereas the two older formations are present everywhere beneath the beds of later age. Especially to the west, it is in irregular remnants of slight thickness between the St. Peter sandstone and the Pennsylvanian series ("Coal Measures"), or else is missing. In most of these patches it is not more than 20 to 50 feet thick. Westward and southward it thickens considerably and it is also more persistent. At Lowell it has been reported about 200 feet thick, at Marseilles it is 56 feet thick, and the Chicago, Rock Island, and Pacific Railway well at Morris records a thickness of 200 feet.

The Platteville in this region is a limestone formation. The color is commonly a light drab, which changes to buff on weathering. Its texture is finely to moderately crystalline. On Au Sable Creek the lower part of the formation is gray, crystalline limestone containing large plates of calcite and disseminated particles of zinc blende and pyrite, appearing as shining metallic spots in exposed faces. Perhaps the most distinctive feature of the limestone is its unusual hardness, which has given to it unfavorable notoriety, particularly among well drillers. As it is of quite uniform composition, it weathers very evenly. Thin films of clay between beds of purer limestone cause it to weather into thin slab-like layers, whereas in fresh cuts it appears massive. The formation carries abundant fossils, but these are confined mostly to certain beds. Among the fossils the shells of brachiopods and the cylindrical stems of crinoids are most abundant.

The Platteville rests unconformably upon the St. Peter sandstone. In Deer Park Glen, immediately above the falls, a good exposure may be seen, which shows the contact as an irregular wavy line. Again at the Federal Plate Glass Company's plant west of Ottawa and on Covel Creek, the unconformity is well shown. In this section the Platteville-Galena lies in depressions in the St. Peter sandstone. A cross-section on Covel Creek is represented diagrammatically in figure 11, which shows outcrops of St. Peter sandstone rising well above the strip of Platteville-Galena limestone which they enclose. The uneven base of the Platteville-Galena may also be seen along the bank of the Illinois opposite the mouth of Covel Creek.

### RICHMOND LIMESTONE

The next younger formation of this region, the Richmond limestone, is the surface formation in the extreme eastern part of the area. It is wanting between Morris and La Salle, but at La Salle, it is again found far beneath the younger "Coal Measures." East of Morris, between Morris and Au Sable Creek, it is covered by a slight thickness of the "Coal Measures." The westernmost outcrop is on Au Sable Creek, almost directly above Sand Ridge. Thence outcrops continue up the Au Sable far into Kendall County. Southward it outcrops widely on the valley floor between the canal and the river and again south of the river. At Goose Lake the line of outcrop bends sharply to the east and thence loops back to a point about a mile below the head of the Illinois. The country here is flat and outcrops are few and indistinct.

As exposed within this area, the Richmond limestone consists of the eroded remnants of a formation which was later buried by "Coal Measures." Its thickness is therefore very irregular and slight, compared with its development east of this region.

The Richmond limestone is the only member of the Cincinnatian series, recognized in outcrops in this region. (Cincinnatian is a group name for the upper part of the Ordovician system.) The formation is rather uniform in its characteristics—massive, coarsely crystalline, and high in iron content. When fresh the stone is hard, but it weathers rapidly into thin beds and assumes a granular appearance because of its coarse texture. This formation is by far the richest in fossils of any in the region; fossils in great number, variety, and range of size, crowd its beds.

The Richmond beds doubtlessly rests unconformably on the underlying Platteville, though no contact has been seen in the region. It is known, however, that several formations of intermediate age are missing, and this absence records a break in deposition.

### NIAGARAN LIMESTONE

The Niagaran limestone does not outcrop in this area, but is prominent to the east. West of La Salle the limestone is reported in well drillings.

### PENNSYLVANIAN SERIES

In each of the formations described above, a distribution marginal to that of the next older formation is to be noted (Pl. IV). As one goes toward the vicinity of Utica from either east or west the younger formations disappear successively, and older ones come to the surface in their places. Lying over parts of all the formations mentioned heretofore, are the Pennsylvanian series of strata belonging to the Carboniferous period. This series is commonly termed the ''Coal Measures.''

With the exception of narrow belts restricted almost wholly to valleys, the ''Coal Measures'' underlie the entire area west of Au Sable Creek. The relations to the older formation are shown by the cross-section on Plate II. East of this region the ''Coal Measures'' outcrop in a narrow, irregular belt in the valley of Dupage River. The northern limit does not extend beyond La Salle County, but the formation has a great extent west and south.

The ''Coal Measures'' of this region were deposited in an extensive, shallow basin, the long axis of which stretches southeastward from La Salle to the mouth of the Wabash. The beds dip toward this axis except where they have been deformed, and toward this axis the formation thickens. At Morris (on the rim of the basin) it is only 64 feet thick; in La Salle County (near the axis) the maximum thickness is reported at 570 feet; in Bureau County, west of the axis, the formation varies from 250 to 400 feet in thickness. The great variations in thickness are the result (1) partly of the unequal deposition in a great basin made up of several minor basins, so that the original thickness was variable; (2) partly of unequal erosion or removal of unequal amounts from different parts of the area during the long period of exposure at the surface.

One of the most striking characteristics of the ''Coal Measures'' is that almost all sediments are repeated again and again in any considerable vertical section. Figure 12 shows the following succession of beds on Cedar Creek: (1) shale, (2) coal, (3) shale, (4) limestone, (5) shale, (6) coal, (7) shale (overlain by drift.) Not only do vertical sections of the ''Coal Measures'' vary greatly, but most beds vary horizontally within short distances, both as to thickness and kinds of rock. The basal beds in some places are sandstone, and in others clay as at Lowell, where potter's clay is found below coal No. 2. Above the ox-bow of Mazon Creek these horizontal changes are well shown: (1) At the ox-bow, at the base of the

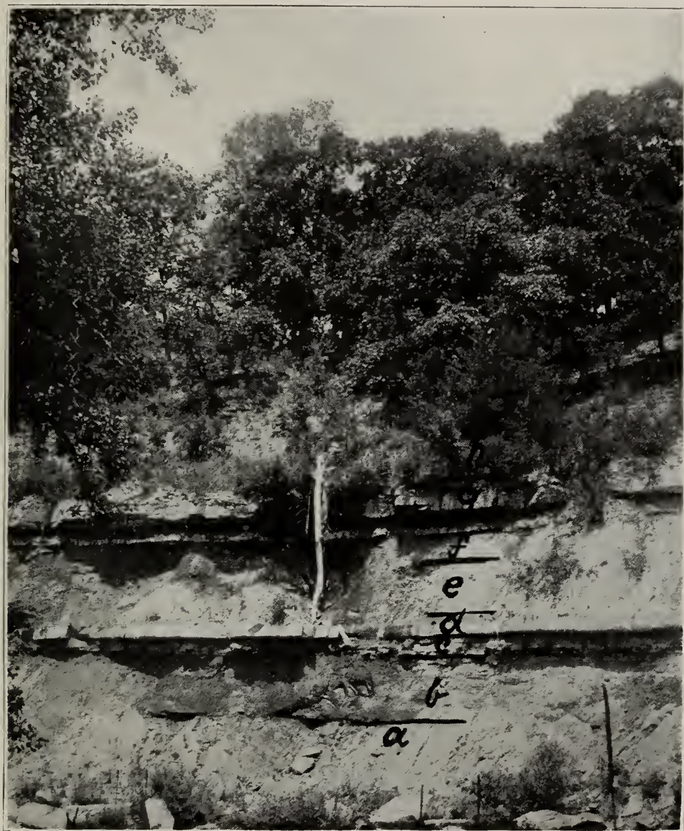


FIG. 12.—Exposure of "Coal Measures" on Cedar Creek. This section shows well the variety of strata in the "Coal Measures": *a*, shale; *b*, coal; *c*, shale; *d*, limestone; *e*, shale; *f*, coal; *g*, shale; and *h*, cover of glacial drift.

bluff, is a shaly limestone, upon which lies soft, blue clay, and upon this, a thin sandy shale. (2) Upstream the blue clay becomes shaly, and the shales grade into sandstones. (3) Farther on all give way to sandstone. (4) Upstream again this sandstone becomes a sandy shale, and (5) finally in the shale thick beds of blue clay appear over thin beds of impure limestone.

Coal beds vary greatly in thickness within short distances; above the Farm Ridge crossing of Big Vermilion River, may be seen a sandy bituminous shale which stains the water with oil. Southward this bed develops into a workable coal seam. From these widespread and irregular variations it is judged that the beds were deposited under very unstable and variable conditions.

In spite of these variations, sediments in the "Coal Measures" show characteristics which set them off from other formations. The Carboniferous sandstones are distinguished from all other sandstones of the region by the flakes of shining mica and the small crystals of calcite which they carry. The sandstone varies from very shaly phases, as found on Mazon Creek, to a freestone used for building purposes, as on lower Au Sable Creek. The sandstone is cross-bedded (thin beds at an angle with the main bedding planes,) in places so sharply as to appear deformed. The best development of the sandstone is along the margins of the old basin, particularly about Morris, where it appears that sand was accumulating at the same time that clay was being deposited in deeper water to the south and west.

The clays and shales likewise bear a strong resemblance to each other throughout the series. At certain horizons they are the most persistent members of the series. The texture is in many places marvelously smooth, particularly that of the fire clays which are almost without grit, and become plastic when wet. Good exposures of thinly cleaving (slaty) shales may been seen on the Big Vermilion below Lowell. Other phases are represented in various places. Pyrite is found in the fire clays. As a result the fire-brick companies prefer to use the clays near the surface, from which the pyrite has been removed by oxidation and leaching.

Concretions are very prominent in the "Coal Measures." Near the mouth of Tomahawk Creek, the creek bottom is covered by large, generally flattened, concretions. Most of them are at least three times as long as wide, and many reach 6 feet in diameter. The concretions are peculiar in that they are crossed by several sets of radial cracks, which break up their surfaces into rude geometrical forms (trapezoids). The cracks are filled with colored crystals, composed largely of calcium carbonate, or with shaly matter harder than the body of the concretion. These concretions are known as *septaria,* and were formed by the cracking of the concretions subsequent to their formation, and the filling of the cracks with mineral matter deposited from solution, forming veins. Septaria may be seen at Lowell and on some of the eastern affluents of the Fox. The widely distributed ironstone concretions, often of fantastic shape, and the fern-concretions of Mazon, also belong here.

Limestones are developed extensively in the upper part of the "Coal Measures" only. They are best represented west and south of the area of older rocks about Utica. The uppermost limestone has been named the La Salle limestone, which outcrops particularly along the two Vermilion rivers. Bailey's Falls are over it, and along the line of its outcrop are located the Portland cement plants of La Salle and Portland. It has an upper and a lower phase, is finely crystalline, of a blue-gray color, compact, thick bedded, moderately fossiliferous, and in places mottled with vein calcite. The limestone contains a varying amount of clay and a little iron oxide.

Coal is the least of the formations in quantity, but its economic value is greater than that of all other local mineral resources. Of the half dozen

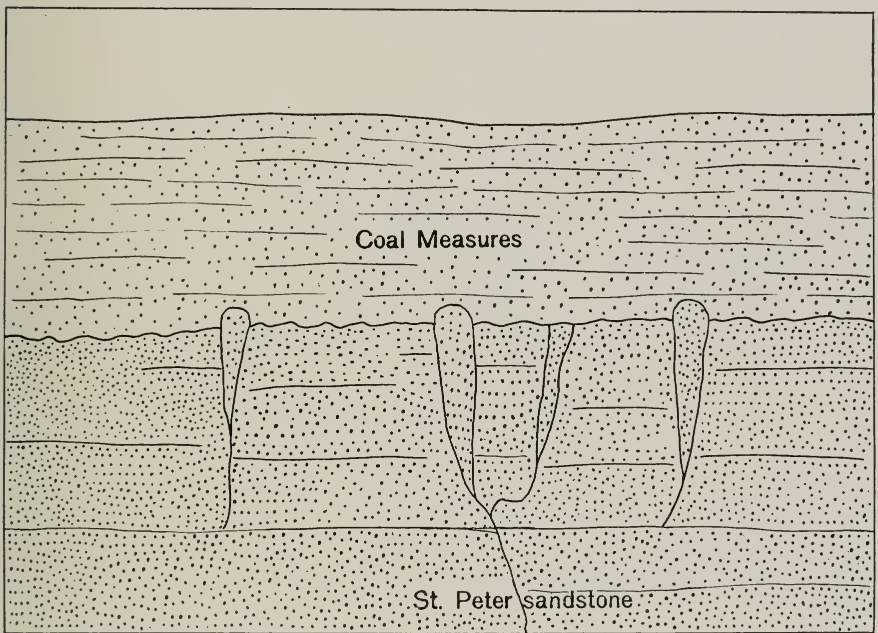



FIG. 13.—Diagrammatic illustration of the unconformable relation of the St. Peter sandstone and the Pennsylvanian ("Coal Measures") series.

coal beds in a single section, not more than two or three are of economic importance. The most valuable coal bed is about 12 feet above the base of the series. This is coal No. 2, familiarly known as the "Third Vein" coal. The bed averages about three feet in thickness, and furnishes coal of unusually good quality. Two thicker beds of poorer coal lie above it. The coal varies considerably in hardness and composition. Particularly undesirable are concretions of pyrite, which form platy clusters or have replaced portions of stalks or of bark.

The unconformable relations of the "Coal Measures" with the underlying formations may be established in almost any section that shows a contact with one of the older formations. At the crossing of the

Little Vermilion along the La Salle-Dimmick town-line road, the relations of figure 13 are shown. Here the basal Carboniferous or "Coal Measures" sandstone lies on the St. Peter sandstone. The latter was fissured, the fissures were filled, and then erosion wore down the sandstone so that the vein fillings stood out in relief before the first "Coal Measures" sands were deposited upon it. In many places the "Coal Measures" may be seen lying in a depression in the older rock, similar to the Platteville noted above. The position of the "Coal Measures" upon each and all of the formations of the region serves to establish its unconformity with all but the youngest underlying formation. Field evidence of a break in the history of sedimentation between the Richmond limestone and "Coal Measures" is lacking. It is known however that all the formations of two great intervening periods, the Silurian and Devonian, are wanting.

Within the "Coal Measures" are numerous minor and local unconformities. These represent only short intervals of erosion in limited areas, and are not comparable to the breaks between larger divisions of the geologic series. An unconformity of this sort may be seen in the eastern part of the city of Marseilles, where "Coal Measures" sandstone may be seen overlying "Coal Measures" shale with an erosion contact. On Covel Creek, half a mile south of Hitt's, eroded shale is overlain by sandstone.

## Structure of the Rocks

### General Southward Dip

In most sedimentation, the beds are laid down in layers that are almost horizontal. Sediments are deposited normally on gently sloping surfaces, either on the floor of a sea or on low-lying land. The beds thus formed have a slope which may be too slight to be noted by the eye. The sea encroached upon this region from the south, and the sediments on its sloping floor had a slight southward dip. This may be shown by the fact that to the southward successively younger formations are encountered, and that the elevation of the various formations above sea level decreases constantly, although slowly, southward. The Potsdam sandstone outcrops at the surface several hundred miles to the north of this region; here it is about 600 feet beneath the level of the sea. This obscure depositional dip, however, is locally masked by deformation which has warped every formation of the region out of its original position.

### La Salle Anticline

The older beds in the west-central part of the region about Utica have been brought to the surface by their upfolding into a great arch, or *anticline*. This anticline crosses Illinois Valley between Utica and the two

Vermilion rivers, crosses the Little Vermilion on Tomahawk Creek and again below Dimmick, and is again seen to the northwest at Dixon on Rock River, where it brings the St. Peter sandstone to the surface. Southward it passes out of this area at Lowell. The axis of the fold is about N.20°W. (in the shaft of Black Hollow mine recorded as N.12° W.) Its general course is shown by the outcrops of the inclined La Salle limestone which run northwestward from the bluffs of the Illinois at a point half a mile west of Split Rock to the Little Vermilion.

The line of greatest uplift, or the axis of the fold crosses the north bluff of the Illinois about at the mouth of the Pecumsaugan canyon, for here the Prairie du Chien, the oldest formation, is at its maximum elevation. On both sides the beds dip away, more gradually on the east than on the west. The western flank of the fold shows dips exceeding 30 degrees, which carry the Prairie du Chien limestone beneath the valley floor within half a mile of the crest of the fold, where the limestone outcrops more than 160 feet above the river. The dip on the western flank is so steep that the outcrops of the various formations are tilted nearly on end the entire St. Peter sandstone, for instance, having a surface outcrop only about 120 yards wide. On the eastern flank of the fold the dip is very gentle, not over 5 degrees, and the beds are in many places apparently horizontal. As a result the outcrops are wide; the eastern limit of the outcrop of the Prairie du Chien limestone is two miles east of the crest of the fold. The width of outcrop of the St. Peter sandstone on the eastern flank of the anticline, with the same thickness as on the west, is about 11 miles. These comparisons show strikingly the unsymmetrical character of the fold (see Plate II).

In the bowing up of the strata a great many beds of greatly varying resistance were involved. The weakest beds yielded most readily. On the western flank of the fold where the deformation was most severe, the shaly beds in the Prairie du Chien formation have been crumpled into sharp folds, whereas the beds of limestone and sandstone between are tilted, or perhaps broken, but not crumpled. Where the more resistant beds were broken in the deformation, the clay was forced in around the fragments, filling the spaces between and giving the rock a brecciated character.

The La Salle anticline was not developed all at one time. The folding consisted of several movements extending through long periods of time, which did not cease finally, until long after the first beds were deformed. The Prairie du Chien shows beds which have been deformed more than any later ones. These beds and other rather indefinite data suggest the possibility of a first deformation after the deposition of the Prairie du Chien limestone. There is positive evidence of deformation between the Platteville-Galena epoch and the beginning of the "Coal Measures" period. During this interval, the first great bowing up of the strata occurred. At the close of the ''Coal Measures'' period, the beds were again deformed. These two great periods of deformation find confirmation in many places along the western flank of the fold. In many places the Platteville and older formations show dips of 30, 32, and 40 degrees, and directly overlying them are the Carboniferous beds having a dip of less than 20 degrees and commonly less than 15 degrees. Good exposures of this disparity of dip between the ''Coal Measures'' and the older formations may be seen at Split Rock, and on the Big Vermilion just above the mouth of Deer Park Glen.

### MINOR DEFORMATIONS

Upon this large fold, minor folds were developed locally. The most notable are listed as follows: (1) Opposite La Salle at the suspension

FIG. 14.—Small syncline in the ''Coal Measures'' along Big Vermilion River below Lowell.

bridge on the Little Vermilion a trough, less than twenty feet deep, has been formed in the La Salle limestone. (2) Another minor syncline (structural trough) on the Big Vermilion is illustrated in figure 14. (3) The St. Peter sandstone shows several deformations, notably at Wedron on Fox River. On the eastern flank of the anticline, the gentle eastward dip carries the St. Peter sandstone beneath the surface a short distance above Ottawa (both in the Illinois and Fox valleys). Farther up Fox Valley the formation reappears in three prominent outcrops about Dayton, about Wedron, and about Sheridan. At Wedron the sandstone rises more than 120 feet above the normal elevation of its surface. At this place the sandstone is domed up, and dips to the south. A lesser bowing has probably exposed the formation in the river bed at Dayton. (4) Sags and swells abound in the "Coal Measures," although they are of very slight extent, both vertically and horizontally. In the Morris basin almost every creek shows such minor warpings of the beds. They appear through a considerable part of the "Coal Measures" series, indicating the frequency of crustal warping in the course of the Carboniferous period. Occasionally the beds have been faulted. In shaft No. 3 of the Spring Valley Coal Company a fault has been encountered in which the beds have suffered a vertical displacement of 11 feet.

These minor deformations are rather more common here than in most similar areas. The *may* be connected causally with the development of the larger anticline.

## History of Formation of Hard Rocks

Geologic time has been divided into five principal eras. The history of the bedded rocks of this region falls entirely within the third of these, the Paleozoic, which includes the oldest sedimentary rocks with abundant remains of life. Of the oldest Paleozoic period, the Cambrian, there is no surface record here, but the buried Potsdam sandstone indicates that at the time of its deposition this region was covered by a shallow sea, which shifted sand widely over the area of the present interior plains.

The second Paleozoic period, the Ordovician, was probably begun by a change to a clearer sea, in which marine life was abundant and formed in large part the beds of the Prairie du Chien limestone. Occasionally, the waters were disturbed by waves which carried in thin deposits of sand or mixed silt with the organic remains on the sea floor. The variable nature of the beds may point as well to rather frequent slight changes in the depth of the sea, putting its floor at times within reach of wave drag, and at times of deeper water protecting it from such agitation. The early Ordovician sea spread widely over the central states, the nearest land being in northern Wisconsin. It is known to have persisted for a very considerable time, allowing the deposition of a considerable thickness of limestone on the floor of a slowly sinking sea bottom.

Later the sea withdrew from the region, and the newly formed land was exposed to weathering and erosion by streams. The land surface became gullied and generally uneven. This erosion interval is expressed by the unconformable contact between the Prairie du Chien and the St. Peter formations. Observations made in other regions indicate that the withdrawal of the sea was widespread and affected an area much greater than northern Illinois.

The third scene in Ordovician history was introduced by another depression of the land. It is possible that the sea encroached again over the region, but if so the water was somewhat less extensive and shallower than before, for in it sands only were laid down. These later hardened into the St. Peter sandstone. It is possible that from some rather nearby land area, probably northern Wisconsin, rivers may have brought down great masses of sand to the sea coast, there to be shifted about by the wind and the waves. The conditions during the deposition of the St. Peter sandstone were wonderfully uniform, as the sandstone shows almost no variation from top to bottom. This may be explained by a slowly and uniformly sinking land surface, by which the conditions for the deposition of sand were maintained constantly. This period of depression was of relatively short duration; the deposition of 200 feet of sandstone required probably but a fraction of the time which was needed for the formation of the Prairie du Chien limestone.

Again the land was elevated and the surface of the St. Peter formation eroded. This erosion interval is not established over as wide an area as the preceding one.

The Platteville sea which followed was perhaps more extensive than any since the Potsdam. The limestone is very uniform in character, and indicates deposition in water sufficiently deep to prevent the washing in of mud. Later the sea became more shallow, and mud was again swept in to form, after a time, the Cincinnatian shales. Another deepening of the sea brought with it abundant shell-bearing life, which accumulated in the beds of the Richmond limestone.

After the deposition of the Richmond limestone, the sea withdrew again, and throughout the middle west a long interval of erosion followed, terminated by the invasion of the Niagaran sea, in which accumulated one of the most notable limestone formations of the interior. Another oscillation caused the region to emerge from the sea and brought it into a position to be eroded. After this time submergence of the land is not known to have taken place until the Pennsylvanian (''Coal Measures'') period. If there was submergence in the meantime, as in the Devonian or Mississippian periods, that fact is not known. If formations of these periods were ever deposited here, they were completely removed by erosion before the period of the ''Coal Measures.''

The first great recorded growth of the La Salle anticline occurred after the deposition of the Platteville and before the formation of the ''Coal Measures,'' as shown by the contrasted dips of these formations. Deformation may have begun in the Middle Ordovician period, even during the Platteville epoch. The bowing up of the anticline was doubtlessly very slow. The arching may have elevated the older beds above sea level, and exposed them to erosion, at the same time that sediments were accumulating around the deformed area. This would account for the absence in the anticline of beds intermediate between the Platteville-Galena formation and the ''Coal Measures.''

In the "Coal Measures" period sediments were again deposited over all the area. Deposition may have been due in part to the gradual wearing down of the land surface by stream erosion, which reduced it to a low, marshy condition, with sluggish streams; but the region was also at times beneath the sea. In contrast to the previous uniformity over large areas there were in the "Coal Measures" stage many small and variable basins in which deposition took place. Muddy water, clear water, and exposed land surfaces were within short distances of one another, and deposits of mud, sand, and limy material took place contemporaneously, while adjacent areas perhaps received no deposits at all. The greatest uniformity is found in the limestone members of the series, formed during epochs of depression while the sea level stood safely above the entire surface of the region. The greatest variety of conditions was recorded while the region lay about at the sea level, and very slight oscillations furnished the conditions for erosion, or for the deposition of coal, shale, sandstone, and sometimes of limestone.

At the beginning of the "Coal Measures" period, beach conditions prevailed, under which much sand was shifted about. Marshes formed at the edges of the sea, and in them accumulated vegetable material which later formed coal. Oscillations of the sea level were very numerous, but a general tendency toward greater submergence became marked as the period progressed. Slightly submerged marshes gave way more and more to deeper waters, and these in turn to the open sea in which the formation of sand and shale was succeeded by that of limestone. The upper horizons of the "Coal Measures" are largely limestone, and indicate marine conditions for rather a long time toward the close of the period. Most of the Pennsylvanian limestone is in the upper horizons of the series, and most of the coal is in the lower. Shales are most pronounced in the upper part of the series.

After the close of the period, deformation affected the central area again. Along practically the same axis as before, the beds were again folded, but not so severely as in post-Platteville-Galena time. Perhaps this folding was a minor expression of the great movements that were then taking place in many parts of the earth, as in the Appalachian region, and which brought the Paleozoic with its ancient forms of life to a close. With this uplift the history of marine deposition in this region closes. The great interior sea withdrew permanently, and the later history deals with processes that shape land surfaces and not with the beat of ocean waves.

## Pre-Glacial Topography and Its History

### CHARACTER OF BED-ROCK SURFACE

Outcrops of bed rock are widely distributed, but occupy only a very small part of the surface of the region. In most of the area the bed rock is concealed by a thick cover of clay, sand, and gravel, of very unequal and irregular thickness. The present surface of the land shows only a slight similarity to the surface of the bed rock. A reconstruction of the buried bed-rock surface could be attempted only after an exhaustive study of the region, particularly after a close notation of elevations of outcrop, and an elaborate cataloguing of well records to show the distance of bed rock beneath the surface. The material for such a reconstruction is not now at hand, so that only certain large features can be stated definitely, and suggestions given which point to other conditions.

On the whole, the surface of the bed rock is much more irregular than the present land surface, the thick drift cover hiding entirely in several places, ridges and depressions in the bed rock, having a vertical extent of several hundred feet. If these depressions and elevations could be traced in their entirety, they would be found to form buried valleys and ridges. Were the drift cover stripped from the region, the place of the present flat prairies would be taken by a region of rather sharp valleys and narrow, ridged uplands. These valleys were more numerous and deeper than those of the streams which now drain the region.

The major buried depressions known are as follows:

1. In the western part of the region the surface of the bed rock declines into a great linear depression which runs southward from Rock River to Princeton, and thence follows the line of the Illinois. The present surface of the land lies quite generally well above 600 feet above sea level. At Spring Valley the surface of the bed rock is about at 600 feet. North of Marquette it declines to 500 feet. Bed rock has not been found at an elevation greater than 400 feet at Depue or in Hennepin Township, Putnam County. Four miles farther west, at Bureau Junction, the rock surface is only 340 feet above sea level. West of Princeton the rock surface again rises rather sharply.

These records furnish a section across a buried valley, parts of which are covered by at least 350 feet of loose materials, and of which the present surface of the land shows no trace. Leverett[2] has reconstructed this old valley southward from Rock River to its junction with the present line of the Illinois at the "Great Bend." Where it joins the valley of the Illinois its floor is a hundred feet beneath the present channel. It has been suggested by Leverett that this buried valley may be in part the pre-glacial valley of Mississippi River. Certain it is that here was a pre-glacial valley, greater than the present Illinois Valley, both in depth and width, and it probably held a stream larger than the Illinois of today. Figure 15 is an attempted reconstruction of the old drainage system. Well records indicate several affluents to this buried valley above Hennepin.

[3]Leverett, Frank, U. S. Geological Survey Mon. 38, Chap. 12, Pl. XII.

One of these probably has been occupied by the Illinois below La Salle. That part of Illinois Valley with an alluvial floor below La Salle is considerably older than the rock-floored valley above. Very clear indications of this older valley are given above the bend. At Allforks Creek and at Marquette, the old valley bottom is at the very least 50 feet below the present channel. Another tributary appears to have come in from the northeast through Hollowayville and Ladd.

2. From La Salle to Marseilles and beyond, the elevation of the bed-rock surface is rather uniformly at about 600 feet above sea level.


FIG. 15.—Reconstruction of the Rock-Illinois Valley. The dashed line is the course of the present Rock River (after Leverett).

Buried depressions have been observed in but few places, and these record small steep-sided valleys cut in the general pre-glacial upland which occupied central La Salle County. On Buck and Indian creeks above Wedron, such old valleys are exposed in cross-section along the sides of the creeks. North of Marseilles, however, particularly through central Miller Township, well drillers have encountered repeatedly a large depression which appears to follow a northeast-southwest line, and which in at least one case reported descends to about 475 feet above tide.

3. South of Illinois Valley, another large buried drainage line can be traced for a distance of about 10 miles. This line has been followed from the Farm Ridge crossing on the Big Vermilion River, eastward to Grand

Ridge. Beyond, a number of wells in Grand Rapids and Brookfield townships record apparently a continuation of this valley to Illinois Valley above Seneca. In a series of wells west of Grand Ridge, the bed-rock surface falls to at least 430 feet above sea level, and a drilling near Vermilion River passed through sand and gravel to a depth of 70 feet below the level of that stream.[3] For more than two miles along the Vermilion south of Lowell, no rock is exposed either on the floor or sides of the valley. About three-fourths of a mile above the Farm Ridge crossing the surface materials may be seen resting against a sloping surface of rock, which marks one valley side of the buried river course. This valley, of which this fragmentary record was discovered, appears to have been comparable to the present Illinois both in depth and width.

4. Above Marseilles the elevation at which bed rock is found decreases rapidly. At Marseilles it is still 600 feet, or almost 150 feet above the river, but south of Seneca it drops below the level of the river. North of the river the surface of the bed rock does not descend beneath the valley floor except for a short distance in Erienna Township. In all the region east of Seneca, bedded rock is inconspicuous, and in numerous places its surface is at a considerable distance beneath the Morris Basin, which appears to be another broad, low-lying, pre-glacial valley.

The general character of the bed-rock surface is that of a broad, elevated central region from Spring Valley to Seneca, flanked on each side by an extensive depression—on the west by the old valley at Princeton, on the east by the low Morris Basin. In the central elevated section the maximum elevation of bed rock is quite uniformly in the neighborhood of 600 feet above sea level. The surface is here and there depressed beneath this level, but a line extending across the summit elevations would coincide almost exactly with the 600-foot contour. The even surface of the bed rock is expressed by the level-topped valley bluffs which have but a slight covering of drift. In the frontispiece, the panoramic view from Starved Rock shows plainly the even sky line of the opposite side of the valley, which is rock almost to the top. This view reaches from La Salle to Buffalo Rock and shows the level surface stretching uninterruptedly across the whole anticline and including some of the horizontally bedded rocks on each side. This plane surface cuts straight across a great variety of formations very unequally resistant to erosion, which range from the hard Prairie du Chien limestone about Utica, to the readily eroded Carboniferous clays and shales of Ottawa, and the intermediate St. Peter sandstone. Similarly, away from the valley, wells within this central zone commonly penetrate bed rock at an elevation of about 600 feet. Such a plane rock surface developed upon rocks of unequal hardness, is called a peneplain.

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[4]Information by Mr. Williams of Grand Ridge.

### HISTORY OF PRE-GLACIAL EROSION PERIOD

Between the deposition of the youngest member of the "Coal Measures" and the formation of the drift which covers the bed rock, many geologic periods passed involving great changes in the history of the earth through many millions of years. The youngest bed-rock formation of the region belongs to the ancient history of the earth; the drift cover to modern geologic time. The character of the eroded surface of the bed rock is almost the only local record of what transpired in the time that intervened.

While in many other regions great deposits accumulated in the intervening periods, in most of the eastern half of the North American continent, geologic activity was confined to the wearing down of the land by weathering and stream erosion. During this great interval, erosion was the dominant geologic process within this area, as deposition had been previously. Of the varying fortunes of the region during this long time, probably only the last chapters have been preserved in the character of the eroded surface. This shows particularly two distinctive features: (1) the central, elevated plain, and (2) a well-drained region, considerably dissected, with several broad, low valleys.

The development of a peneplain is a late stage in the long process of erosion. The surface run-off erodes most readily where the material is least resistant and soon develops valleys on the weaker rock. The more resistant rocks thus gradually come to stand out as ridges above the more rapidly eroded softer materials. This differential rate of erosion causes a constantly increasing difference in elevation between the ridges of harder rock and the valleys of weaker rock, until the valleys have been brought as low as running water can erode. When the gradient of the main streams has become too slight for further erosion, slope wash and minor streams flowing down the slopes of the harder ridges still continue actively to remove material. By the wearing down of the harder ridges, while the depressions remain at a constant elevation, relief gradually is lessened; the valleys wait, as it were, for the ridges to be brought down to the level which they long since reached. Finally, when the whole region is brought as low as running water can erode its surface, the ridges disappear and a generally flat surface is the result. A flat surface produced in this way is a base level. When the surface has been reduced *nearly* to flatness it is a *peneplain*. Peneplanation is the only satisfactory explanation for the formation of an extensive flat surface across a region of folded rocks so unequal in hardness as in the La Salle anticline. How often the processes of erosion leveled the land to a monotonous plain, and how often the dying streams were quickened into new activity by uplift of the land, we have no means of knowing. One such cycle of erosion is, however, preserved in the flat summits of the central area.

Peneplanation was followed by an uplift and a reestablishment of vigorous drainage. Valleys were cut into the general flat, and again some of the larger streams lowered their floors to base level, and formed broad flood plains as indicated by the broad valley at Princeton. Central and eastern La Salle County were dissected by smaller streams which had not destroyed the older flat surface. The relief, therefore, was greater then than now. At this point the erosion history was interrupted by the mantling of the old surface by glacial drift.

Although the general history of the interval is concerned with degradational processes, the conditions were afforded locally for occasional sedimentation, as in river flood plains. Lying upon the bed rock and apparently older than the drift are occasional thin beds of gravel. These are known particularly in the western region, and are shown in sections on lower Spring Creek, and on lower Negro Creek. The gravels are of local materials, mostly cherts and quartz, considerably weathered. Similar old stream gravels of probable pre-glacial age may be seen on the east side of Fox River, in the sand pits just above Wedron.

These few fragments comprise the local record of a period of time comparable to that involved in the deposition of all the rocks of this region.

## CHAPTER IV—ICE AGE

### Relation of Drift Cover to Bed Rock

In the weathering of solid rock there is formed gradually a mantle of rock waste on its surface (fig. 16). Such a rock cover has the following characteristics: (1) It grades downward from soil through subsoil into partially decomposed rock, and finally into firm bed rock. (2) Since it is merely the weathered outer portion of the bed rock, its surface conforms in outline rather closely to the surface of the bed rock. (3) Its thickness depends largely on the slope of the surface, being thickest on flats and thinnest on steep slopes. Slope wash keeps pace with or exceeds rock decay

Fig. 16.—Diagrammatic illustration of the relation of mantle rock to the underlying rock from which it was derived (courtesy of U. S. Geological Survey).

on many slopes, so that on hillsides the rock cover is kept at a slight thickness. (4) Since the soil is residual from the decay of the underlying rock, its chemical composition is limited to the range of mineral elements found in the bed rock, and of these it contains for the most part only the relatively insoluble constituents. These characteristics are common to the greater part of the surface of the earth. The upland soils of the region south of Ohio River are of this nature, as are those of southwestern Wisconsin and part of northwestern Illinois.

The rock cover in this region differs from that noted above in several particulars:

1. *Contact between drift and bed rock is commonly clearly defined.* Figure 16 shows contact by weathering; figures 29 and 30 show two types of contact of the local mantle (drift) with fresh bed rock. Figure 29 shows a clear-cut contact between drift and a coal bed. Figure 30 shows *till* (material worn and deposited by glacial ice) at the top of the section, and below is shown till mixed with fire clay and shale. Still farther down the material becomes a mass of disrupted fragments of "Coal Measures" with occasional masses of drift. At the base of the section the fire clay of the "Coal Measures" may be seen in position passing from the upper crumpled beds to the lower undisturbed horizontal beds. This second type of contact, however, is evidently not a gradation due to weathering, but is the result of the forcible mixing of the different materials.

On the whole the sharpest contacts between drift and bed rock are found where the drift overlies a resistant formation, such as one of the various limestones of the region. This is well shown along the Big and Little Vermilion rivers (La Salle and Platteville-Galena limestones), and on Au Sable Creek (Platteville-Galena and Richmond limestones). These harder rocks show planed, smooth, and striated surfaces in many places. On the other hand, shales and clays rarely have a definite contact with the drift. Figure 17 shows a relation of the latter sort from the pit of the Utica Fire

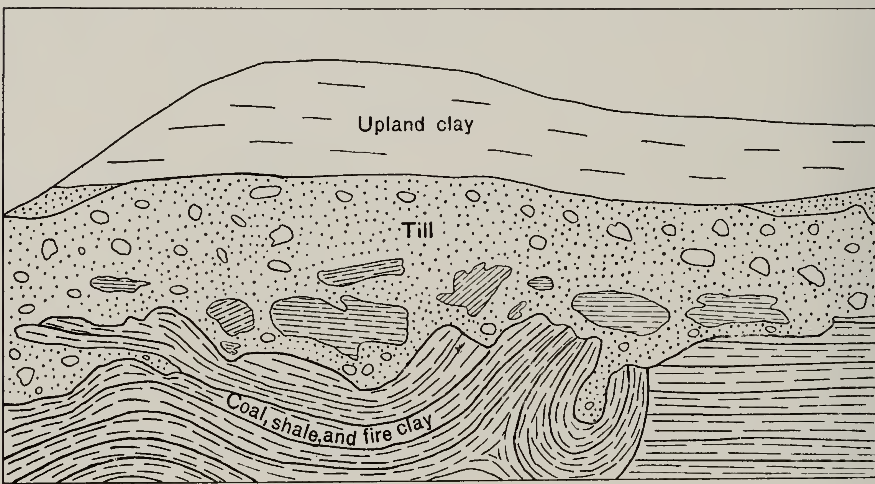



Fig. 17.—Diagrammatic illustration of the indefinite relations of soft bed rock and drift as seen in the pit of the Utica Fire Brick Company near Utica.

Brick Company, half a mile south of the river at Utica. The top of the coal bed is very much crumpled; above it are several inches of residual material; and above this is fire clay mixed with till and grading upward into till. Clay pits between La Salle and Peru on Sixth Street show similar relations between drift and blue clay shales. The nature of the contact varies therefore with the hardness and texture of the bed rock, being sharp where the material is resistant, and indistinct where it is soft. The contact also depends upon the character of the surface of the bed rock. Where the rock forms an elevation, the contact is commonly definite, and in the rock depressions considerable weathered material may be left beneath the drift.

2. *The surface of the drift does not correspond in most places to the surface of the bed rock.* Although the surface of the bed rock falls off sharply west of Spring Valley, the land rises in this direction. Most of the pre-glacial valleys in the rock (see Chap. III) are buried so effectively as

not to leave the slightest surface evidence of their existence. The topography of the upland is entirely the topography of the drift, except along Illinois River, where most of the drift has been removed, and to some extent along Farm Ridge, which appears to be a moraine (ridge of drift) emphasized by an unusual elevation of bed rock.

3. *The thickness of the drift varies greatly,* being thicker in the pre-glacial valleys and thinner above the pre-glacial ridges of rock. The average thickness of the drift is much greater than is common for a residual soil, being well over 50 feet on an average for this region. The thinnest drift is immediately adjacent to Illinois Valley, particularly in the Morris basin. The greatest accumulations of drift known in the region are (1) in the old valley at Princeton, where it reaches a thickness of at least 350 feet, (2) north of Marseilles in Miller Township (250 feet), and (3) east of Grand Ridge.

4. *The composition of the drift* is not limited to the materials of the underlying rock. The drift in one part of the area does not vary markedly from the drift in any other part, although it overlies different formations in different places. Limestone is the most important stony constituent of the drift, whether the drift covers a limestone formation, or rests upon shale or sandstone. In any single section of drift are found not only fragments of almost all kinds of sedimentary rock, but many kinds of rock entirely foreign to this region. They include crystalline rocks, igneous and metamorphic, whose nearest possible source was the Lake Superior region. Averages from the eastern part of the region give fully 50 per cent of the smaller stony material (about 1 inch in diameter) as limestone, about 25 per cent shale, 5 per cent chert, 5 per cent sandstone, and the remainder igneous rock. Dark-colored crystalline rocks (basic igneous rocks chiefly dark schists, trap rock, and gabbros) outnumber the light crystalline rocks of acid composition, such as granite, by a ratio of at least three to one. Among the larger bowlders, the percentage of igneous rock increases materially. Occasionally a glittering bit of hematite tells of its source in the iron country of Lake Superior.

5. *The drift is made up of fresh, not weathered, rock materials.* These characteristics of the drift indicate (1) that the agent which deposited it stripped the loose weathered material from the surface of the bed rock. (2) Some of the bed rock it smoothed or scratched. (3) In places it mixed the drift with the bed rock. This agent also was competent (4) to deposit great thicknesses of drift over wide areas, independently of the character of the underlying surface. (5) The agent which formed the drift collected rocks of many kinds without discrimination as to size, (6) ground them to various sizes and shapes, and (7) transported them great distances. Glacier ice can do these things, and is the only agent which can.

## Materials of Drift and Their Origin

### TILL

The till, bowlder clay or "hard pan" as it is commonly called in this region, forms by far the largest part of the drift. Outside Illinois Valley, it probably makes up more than nine-tenths of the mass of the drift.

Several characteristics of the till show that it was formed and deposited directly by glacial ice:

1. Most striking is the absolute *lack of assortment* of its materials. A typical section of till shows clay, sand, gravel, and bowlders of all sizes mixed together indiscriminately. The main body of the till consists generally of clay (fig. 18).

Fig. 18.—Glacial till along Indian Creek. The section here is about 60 feet. The dark streak slightly below the top of the section is a bed of silt.

2. Another characteristic is the *large size of some of the material* found in the till. Most of it is fine enough to have been carried by vigorously flowing water; but bowlders larger than a man's head are exceedingly common. They are strewn over valley bottoms, left by streams which in excavating their valleys have carried away the fine material of the till but left the large rocks. Here and there fence rows are piled high with rocks taken from adjacent fields. Bowlders weighing several tons are not uncommon, and a few of those in the region weigh ten to fifteen tons. Most of these are of distant origin, consisting of blocks of resistant igneous rock.

Figure 19 shows one on South Kickapoo Creek, weighing about ten tons. The carrying of 10-ton bowlders for five hundred miles or more, as in the case of the one mentioned, demands a transporting agent for which present conditions offer no parallel in this region.

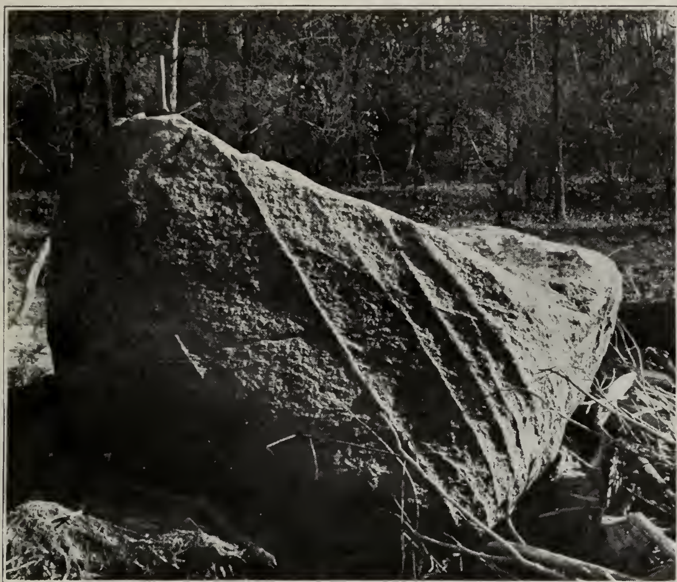


Fig. 19.—Large igneous bowlder on South Kickapoo Creek. Compare the size with that of the hammer on top of the bowlder.

Fig. 20.—Sketches illustrating the characteristics of glaciated bowlders.

3. *Shapes of the bowlders.* Many of the stones of the drift have distinctive shapes, especially flattened sides or faces, which meet at vary-

ing angles and give to the bowlders a subangular form (fig. 20). A well-glaciated bowlder has neither the rounded outline of a water-worn stone, nor the irregular surface and jagged edges of a newly broken fragment of rock. The flat faces have no particular relation to each other, unless the rock has a tendency to break along certain planes. In such cases the rock has been flattened along its planes of cleavage. In addition to planed faces, glaciated stones commonly show linear scratches known as *striae.* Many stones have been well polished on their smooth faces. The degree to which these features are developed depends largely on the hardness and texture of the rock; moderately hard limestones are more apt to show them than friable sandstones or excessively hard igneous rock. The majority of the stones in the till do not show these characteristics to any great extent. Many of them are not very different from water-worn pebbles or broken rock fragments. But so many bowlders are well planed and striated, and so many others show these characteristics to some extent, that they become significant. The subangular forms, particularly, suggest that the bowlders were gripped in a vise and planed. This vise was the ice in which the stones were imbedded and then ground by friction against its bed, and against other bowlders. The stones were polished by the fine material carried in the ice, and scratched by fragments of hard rock against which they scraped.

4. In *chemical composition,* the clay of the till differs from the clays produced by weathering. The latter are known as residual clays. In their making, the soluble compounds of the rock are leached out largely, leaving the insoluble remainder as earthy matter, which if made up of very small particles, is commonly called *clay.* Glacial clay, on the other hand, contains all the constituents originally present in the rocks which were ground up in its formation. It may properly be called *rock flour,* as it is the fine product of the grinding of rocks in the glacier. It is made mostly from the weaker rocks, such as shales which crumbled readily under the pressure of the ice. Fragments of shale are not easily recognizable in the local till, although it is the most common rock constituent. This is due to the ease with which shale was ground up into the clay which forms the body of the till.

5. The till occasionally shows a kind of *cleavage* in wavy lines. Such cleavage *(foliation)* may be seen in the gravel-pits on the lower road to the west of North Kickapoo Creek. These bands are not a feature of deposition, but are due to shearing under the pressure of the moving ice.

## STRATIFIED DRIFT

Unlike the till, the stratified drift is of limited distribution and generally of slight thickness. It was deposited by waters from the melting ice, and its materials were assorted into beds composed of sediments of similar sizes, according to the transporting power of the water which deposited them. Most of the stratified drift shows distinct planes of bedding, but even where these are wanting the material has been assorted by stream action. Much of it is but slightly water worn, as the time during which it was in transport was too short for the development of water-rounded surfaces. The stratified drift may be divided into two classes according to its distribution: (1) that associated with present drainage lines, and (2) that of irregular distribution, not in valleys. Each of these classes may be divided into (a) surface deposits, and (b) deposits covered by till.

1. The most conspicuous beds of stratified drift are those in Illinois Valley and in the valleys of its larger tributaries. The surface deposits belong to two groups. The first group is composed of a series of gravel beds that extend westward beyond the area covered by this report; they lie at high levels, generally near the top of the valley slopes, extend up the

Fig. 21.—Gravel bed of coarsely bedded ''high-level'' gravels on Cedar Creek.

larger tributaries, and occur in beds as much as 60 feet thick. They will be described more fully in the succeeding chapter, as the ''high-level'' gravels (fig. 21). The second group extends into this area from the valleys of the Dupage, Desplaines, and Kankakee rivers, as part of the Late Wisconsin valley train. These beds have no definite limit downstream, but disappear gradually below Marseilles. They are at lower levels than the former group and are confined more nearly to the main valley. They are finer, being, on the whole, sandy rather than gravelly.

Some of the stratified drift of the valleys is covered by till. The two most important groups of this kind are a series of gravel beds between Seneca and Marseilles, best developed on the northern side of the valley in beds up to 70 feet thick to be described later as the ''Kickapoo beds,'' and buried gravels and sands west of Peru extending beyond Spring Valley. The latter are mostly on the south side of the valley, and will be discussed later as the ''Peru beds.''

2. The stratified drift outside the valleys is of sparse and irregular distribution. Here and there patches of sandy or gravelly material may be seen on the prairie. These are of limited extent and slight thickness. An occasional knoll of gravel, known as a *kame,* may be seen along the front (west side) of the Farm Ridge moraine and similarly on the headwaters of Covel Creek; but most of the stratified drift is not so disposed as to make pronounced topographic features.

The materials found in these deposits in general are not so coarse as those in the beds marginal to the valleys. The sands and gravels on the prairie were deposited in large part by water which flowed over a rather flat surface and without great velocity. Bedding is generally obscure and the gravels in many places have some clay mixed with them and are then known locally as *loamy gravels.* In large part, these deposits of stratified drift were left by the water flowing from the receding ice front.

Buried in and beneath till sheets is much stratified drift which has no relation to existing valleys. This drift consists in many places of thin sheets of sand and gravel interleaved with till. Such material is found in almost all the wells of the region. (Sections will be given later.) Here and there thicker bodies of stratified drift lie beneath the surface till. Beds of this sort may record old valleys which were filled in part by glacial waters, and then obliterated by the deposition of till above them.

## LOESS

Loess is typically a loam, intermediate in texture between clay and sand. On microscopic examination it shows many flattened particles. Though altogether uncemented, a vertical face of it once developed will stand for years (fig. 22). The prevailing color is buff, but drab may be seen in places. Shells of land snails (gastropods) are common in loess. Most of its material locally is fresh and quite calcareous, concretions of lime carbonate being abundant in many places. Most loess is now commonly thought to have been dust deposited by the wind. Much loess was formed at various times during the Ice Age. After the retreat of an ice sheet, the sweep of the winds over the bare surface was particularly effective in blowing about the fine material left by the ice. As soon as the climate became mild enough to allow the growth of plants, the cover of vegetation arrested the accumulation of loess. An important source of loess was the silt-laden water that issued from the melting glacier, and built up great mud flats which, in drying, supplied the prairie winds abundantly with dust. There is much silt very similar to loess, associated with the drift of this region, but it contains occasional bowlders which loess lacks. They imply deposition by water, in which floated ice containing imbedded bowlders that were dropped on melting.

East of Spring Valley there is little true loess at the surface. West of Spring Valley it increases in amount, and is well developed on the prairies

Fig. 22.—Loess under gravel on Spring Creek. Note the vertical sides of the loess and the initials carved in it.

about Bureau Creek. Here it attains a thickness of 30 feet in places, and rests either directly on till, or on gravel which overlies till. The prairie east and south of the Hennepin gravel flats is covered abundantly by buff loess. In very restricted patches it is found on top of the drift east of Spring Creek, as on Little Vermilion River immediately above the Matthiessen and Hegeler zinc works, and again east of Ottawa at the crossing of the first tributary above the mouth of Fox River by the Marseilles road.

In this region loess is much more abundantly developed between sheets of till than it is as a surface formation. In this older loess, remains of life are scarce. Good sections of buried loess are found on Indian Creek, and in almost every bank between Morris and Seneca.

#### UPLAND CLAY

Similar in many respects to the loess is a heavy clay which covers most of the upland. Although of almost universal distribution in this region, this *upland clay* is more extensively developed west of the Marseilles till ridge than east of it. The clay in the western region averages about three feet in thickness, and at Spring Valley it is as much as eight feet thick. In the eastern region such thicknesses are unknown. This clay is always the surface formation, and commonly is clearly differentiated from the base upon which it rests. It apparently has no limit in elevation but generally becomes thinner on the higher ridges. Its physical characteristics are very uniform. When cut, the clay is smooth, and shows a well-polished surface. Occasional bits of chert are found in the clay. Its color is brown of varying shades, but in thick sections may be greenish. It has a closer texture than loess and consequently it makes a heavier soil. The clay lies over all kinds of formations, from gravel and till to bedded rock, without showing appreciable variations of character. Its probable manner of origin is discussed in Chapter V.

### Surface of Drift

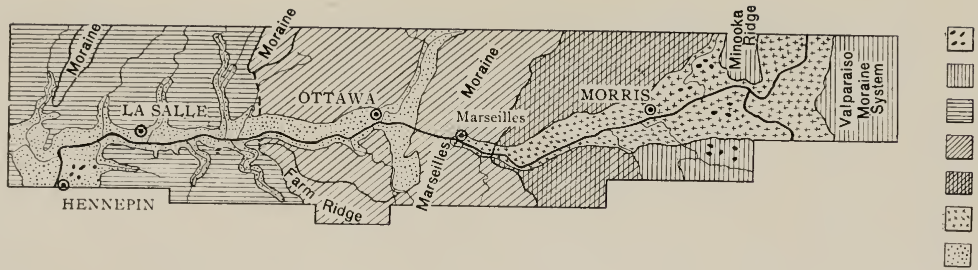
The surfaces formed in the deposition of stratified drift by water are nearly plane, except as modified by subsequent erosion. The surface of the till, however, is undulatory. From a distance it may appear level; but viewed at close range, it is slightly billowy, due to numberless gentle swells and shallow sags. In this region the prairie is commonly so flat that these undulations readily escape notice. Cultivation has helped to destroy them by plowing down the swells and draining the depressions which formerly were emphasized by small marshes. Unlike water, the ice which deposited the drift was able to get rid of its load without particular reference to slope, and to deposit it with an uneven surface.

In some places the till is heaped into long ridges which rise a hundred feet or more above the surrounding prairie. These are known as *moraines.* The principal ones within this region have been previously noted and are shown in figure 23.

### History of an Ice Sheet

#### MANNER OF DEVELOPMENT

The drift was deposited by great ice sheets (glaciers grown to continental proportions) which once overspread the region. Due to atmospheric and climatic changes, it is believed that huge snow fields developed in the northern part of the continent. The snow fields gradually




Sand dunes

Late Wisconsin till

Bloomington till

Marseilles till

Late Wisconsin and Marseilles till both occurring at surface

Late Wisconsin outwash and valley train

Attempted reconstruction of area originally covered by outwash of Marseilles and older stages above the Great Bend now eroded for the most part. The present upland marginal to the valley is largely thinly veneered bed rock.

FIG. 23.—Distribution of various kinds of drift in the upper Illinois Valley.

developed into ice fields similar to that of Greenland. With a sufficient accumulation of snow and ice, motion began through pressure resulting from the weight of the ice, and the ice moved outward from the center of the ice field just as the ice of Greenland is moving out toward the borders of the island. The principal center from which the ice moved into this region was in Labrador.

Within a glacier every particle of ice is moving forward almost constantly. The position of the ice front at any time depends upon the balance between the rate of forward motion of the body of the ice and the rate at which the ice front is melted back. When the ice is pushing forward more rapidly than it is being melted back, the glacier advances; when waste exceeds forward motion, the ice front retreats. Changes of climate caused repeated oscillations of the ice front. At times the ice retreated hundreds of miles, and later it advanced again, perhaps beyond the area which it had lost. The northern part of the United States was thus subjected repeatedly to invasions by great continental ice sheets, which, at the time of their maximum development, reached as far south as the Ohio and the lower Missouri rivers.

### WORK OF AN ICE SHEET

By reason of its great mass, constant direction of motion, and rigidity, the ice worked effectively in modifying the surface over which it passed. The ice secured a load of foreign material (1) by freezing to loose material on the surface over which it advanced, (2) by plowing up such material, or (3) by quarrying it out in dragging its great weight over projecting steep faces of rock, such as cliffs. Gradually the ice stripped the surface of its loose earth and planed down prominences over which it passed with the aid of the rock material carried in its bottom. The rock fragments were used in wearing the bed of the glacier, and they were also shifted about within the ice and thus suffered wear by friction with each other. The extraordinary eroding power of a glacier lies in the rigidity with which it holds the stony material it gathers, so that it uses rock fragments in its base like firmly set graving tools to cut the rock beneath. Thus the stones within the glacier were planed, striated, and made subangular. At the same time, the rock base over which movement took place was smoothed, striated, and grooved.

After getting a load, the ice transported, and later deposited the material which it had gathered. A considerable part of the load was carried within the ice, but most of it was dragged along at its bottom where most material was available. Glacier ice is a much more efficient carrier, both as to amount and size of material, than water. Glacial bowlders, of a size which water could never have moved, were carried from Canada to the Central States in great numbers. The shifting of much of the material was perhaps intermittent, for as the bottom of the glacier melted, the material it carried was dropped to be dragged on again later. At times the ice became overloaded, particularly during periods of retreat of the ice front, and much material was then dumped. Deposition was going on most of the time beneath the ice, but at all times and in greatest quantity at its edge. Here the melting ice dropped its entire load. Since not everywhere was an equal amount of material carried in the ice, deposition was unequal, and an irregular surface was formed. Wherever the edge of the ice remained stationary for a long period, the deposits accumulating beneath its edge gradually built up thick morainic ridges under its margin. Their size is a sort of index to the length of halt of the ice front at a given place.

Associated with the ice were the waters formed by its melting. The most important of these were (1) the waters which collected under the ice from its melting base, and flowed out from beneath the ice to join (2) the waters issuing from the ice edge. Deposition by streams may have taken place, therefore, both beneath the ice and beyond its margin, but mostly in the latter place, as the sub-glacial streams probably carried less material, flowed more swiftly, and were of smaller volume than the great streams which poured forth from the extremity of the glacier, and spread broadly over the surface of the land. Where the waters flowed out upon a flat surface, they deposited their materials in a broad belt marginal to the ice front, and the surface of the outwash was built up with a gentle slope, forming an *outwash plain.* If the drainage was confined to a valley, the materials were deposited in a similarly sloping flat, but greatly elongated down the valley; this is known as a *valley train.* If the waters were ponded, they gave rise to level flats of fine material such as are built on a lake floor. In all these situations, floating fragments of ice with bowlders attached were carried out occasionally, and the bowlders were dropped where the ice grounded., or where its melting caused them to be set free. Because the velocity and hence the carrying ability of the glacial waters decreased commonly with increasing distance from the front, the coarsest materials were deposited first, and finer and finer sediments in succession.

Such was, in brief outline, the work of a single ice sheet. The glacial record shows numerous repetitions and interruptions in the history of glaciation. Climatic changes caused repeated recessions and readvances of the ice. In some cases the ice-free intervals were long enough for the reestablishment of vegetation, and in such cases the till sheets are found separated by buried soils. In North America five or six distinct glacial epochs are recognized, each being separated from the succeeding one by a considerable ice-free interval. During some of the latter the ice is known to have receded hundreds of miles. The duration of the whole Ice Age has been estimated at several hundred thousand to a million or more years.[1]

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[1]For estimates see Chamberlin and Salisbury, Earth History, vol. III, p. 420.

## History of Glaciation in Upper Illinois Valley

### EROSIVE WORK OF THE ICE

The amount of erosion which the ice accomplished in this region may be estimated roughly from the thickness and constitution of the drift. The average thickness is about 50 feet. Practically all this consists of fresh rock materials; rock waste formed by the decay of rock is almost unrecognizable in the local drift. Moreover, on a conservative estimate 90 per cent of the drift is of local origin. A thickness of 50 feet of ground-up rock points therefore to the erosion of an almost equal amount of bed rock by the ice. Such thicknesses of drift, and even greater ones, are common over an area including most of Illinois and southern and eastern Wisconsin. The local thickness of drift, therefore, is not due to particularly favorable local conditions of deposition.

All surfaces were not equally affected by the erosion of the ice. Projecting rock masses were eroded most severely; valleys transverse to the movement of ice were sheltered comparatively from the attack of the ice. The greatest erosion was on the sides of hills facing the oncoming ice, the stoss sides, and in valleys through which the ice passed lengthwise. These stoss sides were planed down greatly, whereas their lee sides were less worn. The ice moved into this region from the north and east so that on these sides of rock hills the drift is thin, and the bed-rock surface has been planed down considerably. On the lee sides of the hills the drift is thicker, and beneath it may be left some weathered rock which was not disturbed by the ice. This relation is shown in the clay pits between La Salle and Peru on Sixth and Seventh streets, in which the material from the north side of the hill (above Seventh Street) was stripped off by the ice, and dumped on the south side of the hill below Sixth Street.

The most readily recognized record of ice erosion consists in the *striae* (scratches) left on the surface of the bed rock. Locally, these are not seen readily, both because many of the underlying rock formations do not preserve such markings, and because the bed rock is hidden by drift in most places. The various limestones have preserved such markings best; because of their superior compactness and even texture they retain the striae in distinct form. The only other formation on which glacial markings of any kind have been observed is the St. Peter sandstone. The best glacial striae observed are on Au Sable Creek, one-half mile south of the Kendall County line; here the Richmond limestone shows well-striated and fairly well-polished surfaces. The general direction of the striae here is east-northeast to west-southwest, the striae being not quite parallel. Some distance below outcrops of Platteville-Galena limestone on the Au Sable show similar scratches. With coarser tools, greater pressure, and less resistant bed rock, deeper markings, known as *grooves,* are made. They are best developed in the St. Peter sandstone west of Ottawa, particularly at the strippings of the Federal Plate Glass Company and in the ravine to the north of them. A fuller description of these grooves is given later.

## EARLY ICE INVASIONS

This region was glaciated repeatedly. The eastern part was overspread by at least four great ice sheets and the extreme western part by three. The latest ice invasion, however, has left thick deposits over most of the surface. Evidences of earlier glaciations must be sought mostly along the undercut slopes of valleys. The older drift sheets have been destroyed in large part, and the distribution of their remnants is very limited. Because till varies greatly from place to place in characteristics and has no systematic limits in its vertical distribution, the correlation of older tills of discontinuous and infrequent exposure may never be reduced to a certainty, but must remain a matter of judgment based on the weight of probability. The central area of this region was an upland in pre-glacial times. It was exposed to erosion by each successive ice sheet, and probably was stripped bare of its cover repeatedly. On this upland even now the till is thin compared with its development in the large buried valleys. Along the margin of Illinois Valley, where exposures are best, the drift is thin, and in many places entirely wanting, due to the vigorous stream action. On the whole, therefore, this region does not present very favorable conditions for the preservation of a record of the older glaciations.

The older buried till sheets are recognized in part by differences in their constitution, but chiefly by the records of ice-free intervals which separate them from the younger surface till. The evidence of an interglacial epoch consists ideally of (1) the remains of plant or animal life, such as buried soil or loess containing shells. Other evidences are (2) the much weathered surface of a buried till, or (3) large beds of stratified drift of widespread development between till sheets. Where a number of these features are developed between two sheets of till the conclusion is that they belong to different epochs.

For considerable periods large areas were freed entirely from ice. During these times the surface was exposed to weathering. Climatic changes may have enabled the growth of vegetation. As the ice readvanced, the weathered and soil-covered surface was largely removed, but here and there remnants were buried which record the existence of an ice-free interval. Portions of the older till sheet may also have escaped destruction. From such evidence, the conclusion is reached that east of Marseilles the deposits of two, and probably three, ice sheets are recorded; west and south of Peru, the record of a still earlier ice incursion can be established. Several selected sections are given below which illustrate the tills at various places. These show remnants of tills so different from the surface till that they may be taken to represent earlier epochs of glaciation.

1. On west bank of creek northwest of Seneca, 150 yards above Marseilles road, a section of about 50 feet shows:

| | | Thickness *Feet* |
|---|---|---|
| (5) | Stony, buff till, very calcareous, with line of bowlders at top | 20 |
| (4) | Pink, gritty till, calcareous (Marseilles till) | 20 |
| (3) | Loess, quite fresh, light and yellow | 2–4 |
| (2) | Gravels, rather fine, weathered | 2 |
| (1) | Basal till—entirely weathered, almost no trace of calcium carbonate left; bowlders, largely decomposed, although they still retain their form; exposed | 5 |

2. On Nettle Creek in Grundy County, immediately below the Erienna-Saratoga township line, a till similar to (1) above may be seen beneath a section of younger blue till. The lower till is thoroughly leached, deeply cracked, and the cracks have been filled with sand. The stony material is weathered, and its striae are effaced. The till is very gritty in texture. Several similar sections are shown on Nettle Creek below the railroad bridge, almost as far downstream as the Morris Township line.

3. On Saratoga Creek a somewhat different phase is developed about one-half mile above the Morris Township line. Here the lower till is a residuum of brown clay with much sand and many rotted bowlders of foreign origin. Immediately upon it rests a highly calcareous laminated lake clay belonging to the last period of glaciation.

4. In the several ravines north of Marseilles a number of freshly cut banks show at their base an old till which has been oxidized and cracked and is very stony. This is separated from the till above by a few feet of lake clays of much later age.

5. The Peru beds furnish evidence of an earlier glaciation. They lie west of Peru and are described in Chapter VI.

6. On upper Cedar Creek, just above its southward bend in Eden Township, a section shows:

| | | Thickness *Feet* |
|---|---|---|
| (5) | Coarse gravels, usually found along valleys in the western region (''High-level'' gravels) | 5 |
| (4) | Smooth, pink till (Bloomington till) | 15–20 |
| (3) | Loess, several feet thick, conforming to the very irregular surface of the bed beneath | .. |
| (2) | Weathered till, much cracked, and stones in it decomposed. The till is highly calcareous, but the calcium carbonate has probably seeped in from above after an earlier leaching | 10–15 |

(1) Gravels and sands, yellowish brown, highly oxidized. In this is much large igneous material, which is thoroughly rotted...... ........... .........

The conditions of weathering of the lower till and gravels of this section point to a long period during which the older till was exposed to weathering before the present surface till was deposited over it.

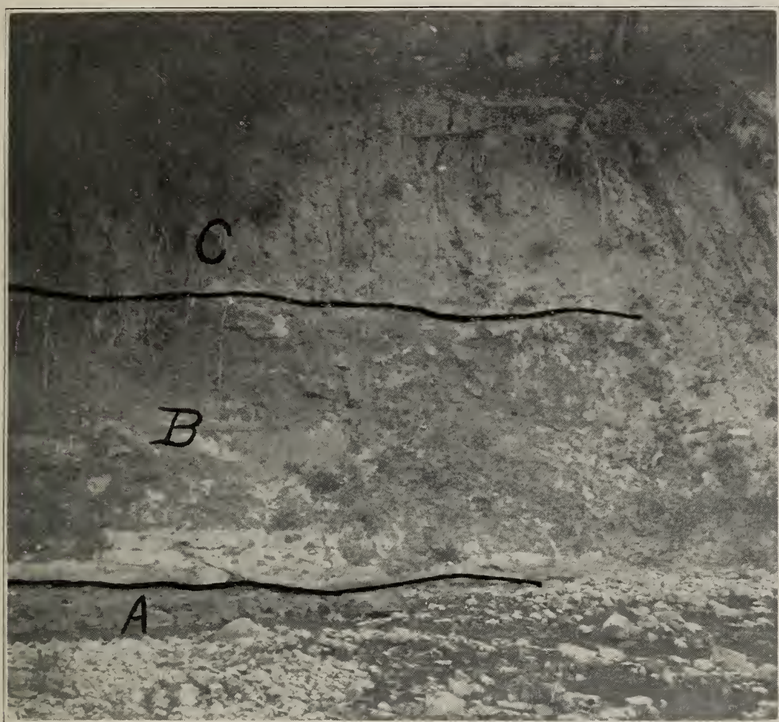


FIG. 24.—Organic deposits buried beneath till on Spring Creek: *A*, old bog containing half-decayed root fibers and many snail shells; *B*, fine loess-like silt; *C*, Bloomington till.

7. On west bank of Spring Creek, about a mile below Dalzell (fig. 24):

| | Thickness *Feet* |
|---|---|
| (3) Bloomington till................................ | 40 |
| (2) Loess ........................................... | 15–20 |
| (1) Silt at base of section crowded with shells and roots of plants .................. .................. | .. |

### WISCONSIN GLACIAL DEPOSITS

#### GENERAL DESCRIPTION

All but a very small part of the till of this region belongs to the Wisconsin epoch of glaciation, the closing epoch of the Ice Age. Most sections of Wisconsin till of any considerable thickness show several till sheets which may remain distinct over a considerable area. Although the distinction between them is clear and persistent, it is not of such a character as to indicate that they are referable to distinct ice epochs, but rather to stages of one long epoch in which the ice front was subject to many oscillations. Outwash is interbedded fairly abundantly with the till.

The variety of conditions during the Wisconsin epoch is well illustrated on Indian Creek at the "High Bluff," just above the mouth of Crooked Leg Creek. This is probably the finest exposure of till in all the region and gives a section of almost 100 feet.

| | | Thickness *Feet* |
|---|---|---|
| (8) | Sand and gravel beneath the surface clay............ | 10 |
| (7) | Blue-gray till, very compact, matrix fine and compact. | 25 |
| (6) | Coarse gravel, material slightly water worn.......... | 6 |
| (5) | Pink till, fresh, gritty, rather stony................. | 35 |
| (4) | Coarse sand and gravel, grading into................ | |
| (3) | Pink clay, thin bedded.......................... | 3 |
| (2) | Blue-drab till, interbedded with sand................ | 15 |
| (1) | Stratified drift, mostly fine, resting upon St. Peter sandstone, almost at creek level................. | .. |

This great section shows a considerable variety of conditions, with three distinct till sheets, but with no important historical break. All the tills of this section are referred to the last glacial epoch.

## BASIS OF SUBDIVISION OF THE WISCONSIN DEPOSITS

The character of the Wisconsin till is probably much influenced by the distribution of the outcrops of the various rock formations over which the ice passed, and this influence furnishes a partial basis for the further subdivision of this period into three minor divisions. The till of the western half of the area and the basal portions of the till in the eastern half, are commonly brightly colored. Two colors predominate in fresh sections, blue (in places drab), and till with a pinkish cast. In many places, though not everywhere, the pinkish till appears to be a phase of the blue till which has been exposed to weathering and is somewhat oxidized. In most places it lies above the blue till, but in a few places single beds show a blending of the two colors. Where these brightly colored tills are observed beneath the younger dull-colored, buffish till which occurs at the surface in the eastern part of the region, the contrast is striking. The surface till of the eastern part of the region is generally buff-drab in color, more clayey and somewhat less stony than the tills below, and carries fewer beds of stratified material. It appears that the older Wisconsin till (in the western part of the area) is most highly colored, that the till of intermediate Wisconsin age (about Marseilles) carries less highly colored clay, and that the youngest till (in Grundy County) is dull colored. The probable explanation is to be found in the distribution of the bed rock. The "Coal Measures" underlie most of the region, but their present eastern margin extends only slightly beyond the head of Illinois River. In this series gaudy clays and clay shales are abundant. In its earlier invasions the ice found these materials farther east than they lie at present, but by repeated erosion gradually stripped them off entirely east of Channahon, and in time exposed the underlying limestones, chiefly of Niagaran age. On this theory, the "Coal Measures" clays were thus largely incorporated in the older tills, and deposited in the western part of the area. The later till, however, was formed chiefly by the grinding up of the limestone that had remained covered more generally during the earlier ice invasions. In this manner the duller color, and greater content of calcium carbonate of the till about the head of Illinois Valley is explained. In this difference of source of materials, in the areal distribution of the different till sheets, and in the persistent development of stratified materials between them, are found the bases for a tentative subdivision of the Wisconsin epoch as outlined in the following paragraphs.

### BLOOMINGTON MORAINE AND TILL SHEET

The maximum extension of the Wisconsin ice carried the ice front westward as far as western Bureau County, and southward as far as Bloomington. At this stage the ice made a long halt and developed a thick terminal moraine, known as the Bloomington moraine, which lies some distance west and south of this region. While the ice covered this region and as it melted away, it deposited a cover of drift which forms the present surface of a large part of the prairies of Bureau County and of western La Salle County. The topography of this region is that of a flat ground moraine with almost indistinguishable swells and sags. The absence of depressions is shown by the lack of marshes and ponds. The general flatness of this surface is broken by the Princeton moraine (fig. 23), which extends northeastward from the river at Depue. This moraine was formed probably during a halt in the recession of the ice.

The Bloomington till is the oldest till of the Wisconsin series, and the most highly colored, probably because it contains the greatest quantity of material from the Carboniferous clays. The till is rather gritty in texture and carries many water-worn stones, particularly cherts. A striking peculiarity of the till consists in the perfect molds which these pebbles leave in the till, due in part to their smooth surfaces, and in part to the compactness of the matrix. Eastward the till appears with considerable regularity under younger till sheets. In the eastern region it is recognized by its distinctive color and compactness, and commonly also by a bed of stratified drift which separates it from the younger till above. The basal tills in the sections previously given show this oldest Wisconsin till. The stratified material at its top is most commonly loess-like silt.

### MARSEILLES MORAINE AND TILL SHEET

The second phase of the Wisconsin ice epoch consisted in its readvance to Marseilles and the formation of the Marseilles moraine, more familiarly known as the Rutland Hills and Mission Ridge (fig. 23). Along this belt, the edge of the ice remained stationary for a long time, and

Fig. 25.—Folded lake clays above sand quarry at Wedron. The light material at the top of the section is till; beneath it lie horizontal glacial clays; next lower at the left hand side of the view is a small fold in a similar lacustrine clay.

made the largest terminal moraine of the region, a till ridge in places 10 miles wide and 100 to 125 feet high. On each side of the river the moraine divides into several ridges, the most prominent of which crosses the Illinois at Marseilles. A smaller ridge crosses the river at Walbridge's Creek, and other minor ridges appear here and there along the moraine. Farm Ridge, near Utica, is probably an outlying western member of the Marseilles series. Although the ice front stood in this general position for a long while, a part of it was subject to minor oscillations, in which it formed these secondary ridges.

The Marseilles moraine appears to have been built after a readvance of the ice front, and not merely during a recessional halt. Its till shows characteristics quite different from those of the underlying till. The two are nearly everywhere separated by thick beds of finely stratified material which could hardly have accumulated beneath the ice. The stratified drift between the Marseilles and Bloomington till is fresh and was derived from the readvancing ice. If the gravel beds along the upper slopes of the Illinois are correctly correlated with this stage, this stratified drift rests upon a surface which in places shows weathering, and even buried vegetation. Below these ''high-level'' gravel beds, east of Utica, a foot or more of peat overlies the Bloomington till.

The Marseilles till is less brightly colored and less compact than the Bloomington till beneath it. In the Marseilles moraine, pockets of irregularly stratified water-worn material are rather more common than in other till sheets. The Marseilles till forms the surface drift eastward from the moraine to the Morris basin. On the whole, the matrix of the till is fine, cuts with a smooth surface, and contains an abundance of striated stones. Good sections are exposed on the tributaries of Fox River, on Covel Creek, and on Nettle Creek.

A section of this till, exposed in the Marseilles moraine at the first sand pit south of Wedron, is illustrated partially in figure 25. The section is as follows:

| | | Thickness *Feet* |
|---|---|---|
| (7) | Gray-pink till, fairly stony (Marseilles)............ | 5 |
| (6) | Sands and gravels of disturbed stratification........ | 8 |
| (5) | Sands and gravels, horizontally bedded.............. | 20 |
| (4) | Drab to blue calcareous clays, horizontally bedded (Bloomington)....... ........... .......... | 5 |
| (3) | Finely laminated buff silts, as many as 50 laminae to the inch in places; the clay is folded into a sharp arch beneath the horizontal drab clays which overlie it............................. | 2–3 |
| (2) | Coarse and ill-worn sediments, and clay, which may be till ........................................ | 0–2 |
| (1) | St. Peter sandstone, surface smooth................. | .. |

The upper till (7) belongs to the Marseilles till sheet. In it are a number of small beds of gravel that are tilted on end. These were picked up by the ice, carried, and deposited while frozen. In (6) the ice overrode a bed of stratified material and plowed up its upper portion. The relation of (3) and (4) in which disturbed lake clays underlie similar undisturbed clays, suggests that the deposition of (3) took place in a shallow lake, in which the ice crumpled up the clays on its floor.

LATE WISCONSIN TILL SHEET, MINOOKA RIDGE, AND VALPARAISO MORAINE

The Minooka Ridge extends northwestward from the head of Illinois River through Minooka, and merges into the Valparaiso moraine north of Will County. Figure 26 gives a view overlooking the Morris-Kankakee

Fig. 26.—Kankakee-Morris flat as seen from Minooka Ridge.

flat from the southern end of the ridge. At its western base flows Au Sable Creek, and on the east Dupage River. At Minooka the ridge has a width of about three miles. It is a moraine that rises about 60 to 80 feet above the low prairie on each side. Its surface is even more devoid of irregularities than that of the moraines to the west, and its slopes are even gentler. Eastward, against the sky line from Minooka, lies the Valparaiso moraine (fig. 27), deposited about the southern extremity of Lake Michigan in a great loop. The Valparaiso moraine forms the divide between Desplaines River and Lake Michigan for a considerable distance. The Minooka Ridge is much smaller than the Valparaiso moraine, and parallels it closely west of the Desplaines and Dupage rivers.

These two ridges and the drift of the country between them are deposits of the Wisconsin ice. The Minooka Ridge has been considered as marking the greatest extension of the ice sheet, a frontier line, as it were, to the great Valparaiso moraine farther east.

Within this area a differentiation of the Wisconsin glaciation into two distinct epochs does not appear valid, as the so-called Late Wisconsin till of the Minooka Ridge is not separated from that of the so-called Early Wisconsin till at Marseilles by any great break. The till has a somewhat different color, being the dull, buff clay of the eastern region mentioned above. It is less gritty, softer, and more calcareous than the tills to the west. Limestone, mostly of Niagaran age, is its all-important stony

FIG. 27.—View across Desplaines Valley. The river is marked by the trees in the foreground, and the skyline by the Valparaiso moraine.

constituent. Stratified drift is almost wanting. The Minooka till may be seen to overlie the older till at many places with a sharp line of contact, and with clearly distinguished characteristics. But beyond these features there is as yet no indication within this region of a break which would warrant the establishment of a separate glacial epoch for the till in the Minooka Ridge.

### MORRIS BASIN

The shallow cuts of till shown in the Morris Basin present a rather uncertain record of the glacial history of this region. The basin lies between the Marseilles moraine and the Minooka Ridge. Previous classifications have placed its surface drift within the Early Wisconsin, and have located the extreme western margin of the Late Wisconsin till sheet at the Minooka Ridge. There is satisfactory evidence that two till sheets are found in the Morris basin, the soft buff till occurring in quantity above the firmer blue till of the Marseilles stage. Many excellent sections are shown in the western part of the basin, on Armstrong's, Bill's, and Hog Run. The following sections show relations typical for the Morris basin:

*Section of Morris basin on lower Bill's Run at the lower road crossing*

| | | Thickness Feet |
|---|---|---|
| (4) | Till, largely derived from (3) | 5 |
| (3) | Blue, bedded clay, very calcareous, smooth, and in places finely laminated | 15 |
| (2) | Typical blue till, compact (Marseilles stage) | 10 |
| (1) | Sands and gravels, horizontally bedded | .. |

*Section of Morris basin on Hog Run, north bank, at crossing of Kankakee and Seneca R. R.*

| | | |
|---|---|---|
| (5) | Buff till, well-glaciated stones | 5 |
| (4) | Blue clay, finely laminated | 8 |
| (3) | Sand and gravel | 3 |
| (2) | Till, blue-pink, compact ... about | 5 |
| (1) | Clear, coarse sand | 35 |

*Section of Morris basin on Hog Run, across creek from above section, and a few rods upstream*

| | | |
|---|---|---|
| (6) | Till, buff, soft ... about | 5 |
| (5) | Blue clay, finely laminated | 20 |
| (4) | Silt and sand | 5 |
| (3) | Pink-blue till, brightly colored, variegated | 10 |
| (2) | Fine sand and good loess | .. |
| (1) | Coarse sands | 20 |

Sections might be quoted at length from this region all of which would show:

(3) A thin capping layer of till, identical to all appearances with the till of the Minooka Ridge.

(2) Stratified drift, largely blue lacustrine clays, of a color and composition which makes them appear to have been closely connected in origin with the till beneath. Figure 28 shows such clays, which are utilized in the tile works at Morris.

(1) At the base is found the typical Marseilles till.

From these sections it appears that the Morris basin was ponded by the Marseilles moraine, which was thrown across Illinois Valley. After the ice of the Marseilles stage had withdrawn from the region, a lake was formed above Marseilles, and thicknesses of clays were laid down in it, ranging in places up to 20 to 30 feet. The accumulation of these clays points to a rather long ice-free interval for this immediate region, though the ice may not have been far away. The readvancing Late Wisconsin ice covered the basin and extended beyond, probably as far as Seneca. This ice-sheet held its most advanced position for a short time only, during which it deposited a thin bed of till over the lake clays of the Morris basin, and then melted back to the vicinity of Minooka.

Fig. 28.—Lacustrine glacial clays at the tile works at Morris. These clays are exceedingly fine in texture and very finely bedded.

LOESS

True loess is confined mostly to the region west of Spring Valley. This may have been blown up from the broad Illinois Valley about Hennepin just after the ice melted from the region. Here deposition by the stream was particularly heavy, the velocity of the water being checked as it entered the larger valley. Extensive deposits of silt probably were made at times, and when dry the silt was swept up out of the valley by the wind, and deposited over the prairie region. Evidence of its eolian origin is found in the indefinite limits of its vertical distribution. It forms a mantle of rather uniform thickness overlying the undulating till surface of the prairie. So even a distribution, irrespective of elevation, could be effected in all probability only by the action of the wind.

### UPLAND CLAY

Distinct from the loess is the upland clay. This was probably formed in part by the waters flowing from the receding ice over the flat upland. The wind aided in the further distribution of the clay and obliterated any original well-defined limitations which it may have had. Other factors were also probably concerned in its development, many of which are still in operation, such as the blowing about of dust by the wind whenever the surface of the prairie becomes dry; the work of burrowing animals, particularly earthworms; and the decay of surface material, aided by vegetation. That the upland clay is more than a residual clay, however, is shown by its universal occurrence in rather constant thicknesses above till, gravel, and bed rock of all kinds, without appreciable variations of characteristics. Unlike residual clay, the clay also shows usually a clearly defined contact with the formation which it overlies. These characteristics point to the aid of either wind or water or both in its formation.

### SUMMARY

In this region are recorded a series of successive ice invasions. Evidence of at least one invasion earlier than those of the Wisconsin epoch is preserved in bits of buried and weathered till, soil, and stratified drift beneath the Wisconsin drift. The Wisconsin epoch seems here to be divided into three stages, rather than into two, the three probably not separated by large intervals: (1) The maximum extension of the ice was attended by the making of the Bloomington moraine; (2) after a recession of fairly long duration, the ice readvanced and formed the Marseilles moraine; (3) during the last stage of glacial extension the small Minooka Ridge was built and a thin sheet of drift probably was spread over the Morris basin. After a slight retreat of the ice in this stage the great Valparaiso moraine was formed. All of these stages had associated with them abundant glacial waters that carried out great quantities of gravel, sand, and silt.

## Advantages of a Glaciated Area

Glaciation has brought to this region a great many benefits, whereas it has entailed drawbacks which are but few in number and small in their significance. For a proper valuation of the importance of glaciation to human interests, present conditions must be compared with pre-glacial conditions as they are thought to have been. These may be reconstructed from the local history of the region, and from a comparison of unglaciated sections with adjacent drift-covered areas similarly situated.

### SMOOTHING OF THE SURFACE

It has been shown that the present surface of the land is much less irregular than was the surface before glaciation. Communication in a region dissected by many valleys is both difficult and devious; roads are forced to take a roundabout course in following valleys or in winding along ridges, and even so, transportation is difficult because steep grades cannot be avoided entirely. The different ice sheets spread a smooth cover over the older uneven surface, and thus made communication easy. (see Chap. II).

In providing an almost level surface, glaciation also has aided agriculture, by making the extensive use of machinery possible, and by minimizing the dangers of soil destruction through erosion. On the prairies, almost every foot of ground may be cultivated. In regions of residual soils, especially if they have much relief, many of the slopes are too steep or have too little soil to be cultivated.

### CONTRIBUTION TO SOILS

1. Glaciation has *increased greatly the thickness of the loose material* that overlies the bed rock. In this region the drift averages about 50 feet in thickness, and almost the entire 50 feet needs only weathering and the accumulation of a little vegetable matter to become soil. Glaciation has thus made provision for a deep soil, underlain by an almost inexhaustible subsoil. In unglaciated regions similarly situated, such depths of soil and subsoil are exceptional, and the thinness of the soils and the consequent danger of their exhaustion are serious problems in most unglaciated uplands.

2. Locally the ice has provided *uniformity in soils* to a remarkable degree. In this region there is almost every variety of sedimentary rock, but the drift which overlies them is nearly uniform in character no matter what formation occurs beneath it.

3. The extremely *high quality of the soil* resulting from glaciation has aided the agricultural development of the prairie region. The soil formed by the weathering of the drift differs markedly from that formed by the weathering of the bed rock in that it contains more soluble mineral matter. These soluble compounds include the most valuable plant foods. In the older drift sheets the loss by leaching is more than in the younger, and the productivity of the soils is correspondingly reduced. The soils of the upper Illinois Valley made from the youngest till sheets, have lost relatively little plant food through leaching.

4. The local drift is composed of rock fragments and rock flour derived from a variety of formations. It contains large contributions from nearly every rock formation for scores of miles to the north and east, and

some from formations hundreds of miles to the north. Since the soil has been derived from rocks of many kinds, it contains a *very wide variety of mineral constituents.* All the elements required for the successful growth of vegetation are present in satisfactory proportions. The result is a soil of lasting fertility, which is suited to the production of most crops which can be grown in this climate. Residual soil commonly contains certain elements in inexhaustible abundance, but because it is limited in its composition to the mineral elements found in the formation from which it has been formed, some important plant foods are not uncommonly deficient. This means that in most residual soils fertilizing becomes a necessity earlier than in good glacial soils. As the region contains some of the best glacial lands in the world commercial fertilizers have played an unimportant part to date in the expenses of the La Salle or Grundy County farmer. The prices of farm land and the crops grown bear eloquent testimony to the fruitful nature of the soil after two generations of cultivation.

5. Another peculiar advantage of glacial soils lies in their *fine texture.* The till of this region contains some groundup sandstone, both from the "Coal Measures" and from the St. Peter formation, mixed with much clay derived from shales and with ground-up limestone. Much of the rock crushed and ground by the ice was not reduced to the fineness of clay, and a small amount of coarse material is therefore found in the till, which gives to the soil and subsoil a certain degree of porosity. The soil of the region on the whole can be classified as a rather heavy clay loam. The advantages of such a soil are numerous compared with the excessively heavy soil formed by the decomposition of certain limestones or shales, or with the light soils derived from sandstone alone. The soil breaks up well under the plow and warms rather readily. It is fine enough to hold water well, and withstands drought splendidly. In its original condition it is somewhat deficient in drainage, a slight fault which has been corrected generally by tile drainage. The fineness of many of its particles also makes the plant food contained in it readily accessible to the roots of plants.

The stratified material interbedded with the till furnishes in places an especially desirable subsoil. In parts of the Morris basin, the thick surface soil of the usual clayey loam is underlain at some depth by beds of sand or fine gravel. The combination furnishes a soil of great productivity, which is particularly warm and well drained.

6. The *contribution of the upland clay* to the agriculture of the region is worthy of separate mention. In the western half of La Salle County, especially along Illinois Valley, the upland clay forms the immediate surface, and determines entirely the quality of the soil. The upland clay is of finer texture, somewhat more weathered than the till, and

furnishes a heavier soil. Near the valley, the till is wanting or very thin in many places, and either coarse gravel or bare bed rock takes its place. The soil which could have formed from gravel or bed rock in the time that has elapsed since glaciation would be of slight thickness. Over all this ice-smoothed, gravel-strewn area, however, is a mantle of upland clay from 3 to 8 feet thick, which has provided this zone marginal to the river with approximately as productive a soil as is that underlain by till. The farm land about Utica is formed largely from this upland clay, which here rests upon the St. Peter sandstone; no difference in fertility can be observed between this soil and that of the till farms of Rutland or Miller townships. Along Cedar Creek are highly productive fields of this clay underlain by 30 or 40 feet of coarse gravel.

Where the upland clay overlies till it has contributed a benefit of a different sort. In many parts of the till-covered country of extreme northern Illinois and Wisconsin, the farmer finds a serious problem in the disposal of the bowlders, large and small, which cover his fields. In striking contrast are the stone-free fields and fence rows of the upper Illinois Valley. The till carries almost as many bowlders here as it does north of it, but most of them have been buried safely beneath the reach of the plow by the mantle of upland clay.

The soils of the region may be divided into three classes: (1) the prairie soils of glacial origin, which cover by far the greater part of the area; (2) alluvial soils, the flood-built lands of the larger valleys, chiefly in Illinois Valley; (3) the soils of the slopes between upland and lowland, which consist chiefly of glacial material modified by soil creep and slope wash. Acre for acre the glacial soils of the prairie are the most valuable and are also most uniform. Differences in value of land in different parts of the prairie are due chiefly to differences in improvements and in distances from markets. The soils of the third class are least desirable, in part because least humus has accumulated in them, and in part because of the drawbacks of their steep and easily washed surfaces. The alluvial lands are less valuable than the prairie soils, because they are subject to floods, because they are so porous in many places as to "burn out" in times of drought, and because they are in part not very rich in plant food. Neither of the latter classes are to be compared in area or richness with the soils of the prairies. The crops of the prairie land are matched by few other sections of our country. To say that land yields as well as the prairies of northern Illinois is to say that the land is of unexcelled fertility. And these prairies are a gift of glaciation.[1]

[2]The prairie soils of La Salle and Grundy counties were valued in 1910 at from $125 to $200 per acre, depending on nearness to market, without considering the speculative values at which certain lands near the cities are held. In the Morris basin the prairie lands averaged about $175 an acre, and about Grand Ridge an average value of $200 was claimed. The sandy soils of the valley train in the Morris basin at the same time were held at from $50 to $75 per acre. Since that time there has been an average annual increase in value of 10 per cent, little prairie land being on the market in 1915 at $200, with prices of $250 not uncommon.

## SHALLOW WATER SUPPLIES

Glaciation has lessened greatly the difficulties of securing a supply of water. Almost every high bank along a stream course shows one or more beds of sand and gravel. Wherever these beds lie below the level of ground water, they collect water in quantity. Wells less than 20 feet deep are abundant on the prairie. The ease with which good water may be secured was a great boon to the prairie farmer. The discovery that the apparently waterless prairies held an easily accessible water supply was one of the greatest aids in their settlement. But the amount of water which these beds of glacial outwash furnish is limited. With the recent development of stock raising, the reservoirs of the glacial gravel patches have become insufficient, and the dug well is being supplanted by drilled wells which penetrate the underlying rocks with their more copious and constant supply.

## SAND, GRAVEL, AND CLAY

The glacial sands and gravels have been utilized rather extensively. Thin beds of gravel are distributed widely over the prairie surface so that generally the farmer can satisfy his needs from some nearby sand or gravel pit. Gravel and sand are commonly found together in the same pit. The most important deposits of sand and gravel, and those which have been most exploited commercially, are limited to Illinois Valley, especially to its western portion and to some of its western tributaries. The gravels and sands of the central and eastern region have a sharper grit, but at the same time also, lie in shallower deposits. In La Salle County the gravel and sand have excellent grit which makes them almost as desirable for construction purposes as crushed stone. Westward the materials are more waterworn; the gravel and sand about Hennepin are quite well rounded, and are therefore not so valuable. It is in the latter area, however, that they have been exploited most extensively, because of the tremendous quantity in which they occur, and the ease with which they may be loaded on cars. All the valley towns have abundant supplies of sand and gravel near at hand. The needs of the larger cities have developed extensive pits on Little Vermilion River, on Spring Creek, and at various points along Illinois Valley. The material below Depue is shipped chiefly as ballast and road metal for the railroads.

In places, especially on Spring Creek, the gravels are so coarse that they may not be used effectively even by screening. Near the base of the gravel lie beds of cemented gravels. When cemented beds occur higher up in sections of gravel, they destroy their economic value because they cannot be removed except at excessive cost.

The glacial lake clays have been utilized to some extent for brick and tile. At present their largest use is in the tile works at Morris, which works pink lake clays (fig. 28) in the manufacture of draintiles. These clays are excellently suited to this purpose, but have as yet been only slightly developed because of the abundance of the superior ''Coal Measures'' clay about Ottawa and Utica.

#### WATER POWER

Glacial deposits obliterated most of the pre-glacial drainage lines. Streams therefore had to begin afresh after the Ice Age in cutting their channels. The valleys are still largely youthful, and instead of holding well-adjusted, gently flowing streams, the streams are swift and obstructed in places by rock ledges that form rapids or falls in their courses.

Upper Illinois Valley has a swift stream and in it are several rapids, as at Marseilles and Starved Rock. The lower pre-glacial Illinois Valley has a gentle gradient throughout, uninterrupted by rapids (fig. 3). The upper valley and its tributaries are a legacy of the Ice Age. The two rapids on the Illinois, those on the lower Kankakee, numerous rapids on the Desplaines, the Fox, the two Vermilion rivers, and several on smaller tributaries, all are expressions of the youth of the streams, which have not yet cut their channels to low grade. These rapids are capable of developing a very considerable water power, a small part of which was used in the beginnings of local industry to drive the primitive mills of the country. Except at Marseilles, this water power today is suffered to go to waste. Unused though it is, it furnishes a vast and permanent resource for the future, the development of which may do much for the industrial development of the region.

### Disadvantages of Glaciated Area

The drawbacks which glaciation has fixed upon this region may be enumerated briefly, because they are not of the same order of importance as the advantages which it has conferred.

#### IMPERFECT DRAINAGE

Because glaciation has obliterated the old valleys, and because sufficient time has not passed for the extensive development of new ones, a large part of the prairie surface is imperfectly drained. Also the soil is somewhat impervious. On much of the prairie, agriculture can be carried on successfully only by tiling, and most of the prairie land has been tiled. In many cases, effective tiling of the heavy clay soil requires a close placing of the tiles at a cost ranging from \$10 to \$50 per acre. Tiling has been used for two purposes: (1) to make marshy land arable, and (2) to give to the prairie surface in general, likely to be ''soured'' and ''soggy,'' better drainage, and hence greater productivity.

### POOR PRAIRIE ROADS

In rainy seasons the prairie roads are heavy and almost impassable in their unimproved condition. Locally, the abundance of gravel and of rock suitable for road metal has enabled the farmer to improve his roads with comparative ease. At greater distances from the large valleys, the maintenance of roads becomes a problem of some difficulty.

### SLOW DEVELOPMENT OF MINERAL RESOURCES

The general presence of a drift cover of considerable thickness over the bed rock has retarded the development of the mineral resources of the region. Along the valleys of the larger streams the drift is thin and has not interfered seriously with the development of mining. Away from the rock exposures along the streams, especially in the western part of the area where the surface of the bed rock is low, mining is of recent origin. Even now the Portland cement industry of the Vermilion district is confined closely to the valley bluffs where the limestone and clay lie near the surface, largely because the drift thickens rapidly back from the river and its stripping becomes prohibitively expensive. Coal mining was begun in the valleys but has recently extended to the prairie by drilling through the drift and upper beds of rock. The towns of eastern Bureau County, Spring Valley, Ladd, Seatonville, and Cherry, are all mining centers which have recently sprung up on the prairie. In La Salle County, Granville and Cedar Point are new places that have developed about prairie coal mines.

# CHAPTER V—GLACIAL DRAINAGE HISTORY OF ILLINOIS VALLEY

## Pre-Glacial Components

During the Ice Age Illinois Valley had a history of singular individuality, which merits discussion apart from the regional sketch of glaciation.

Although the present valley did not exist before the glacial period, it has been developed largely from pre-glacial drainage lines, or at least from drainage lines that antedated the later glaciations. From the "Great Bend" to its mouth, Illinois River inherited a great pre-glacial channel which entered the present Illinois Valley at Depue. This old valley extended north of Depue, but its northward continuation was obliterated by thick deposits of drift, and its existence is known only imperfectly through the records of well drillings (fig. 15). Below the "Great Bend," this old valley served repeatedly as a line of discharge for the waters issuing from various ice sheets.[2] The ancient channel was partially filled with sediments that were washed out from the ice front in several of the glacial epochs. Much of the material thus deposited still remains in the old valley, so that the modern Illinois River flows on thick deposits of stratified drift about 100 feet above the bottom of the older valley. This pre-glacial valley below Depue seems too large for the stream which now flows in it and is in striking contrast with the younger valley of the upper Illinois.

Above Depue, the river appears to have appropriated parts of two pre-glacial valleys. From Utica to Depue the present valley rests upon rather thick deposits of stratified drift, and this part of the valley is believed to have been formed by a pre-glacial tributary to the main valley farther west (fig. 15). Above Seneca the low-lying surface of the Morris basin indicates another pre-glacial channel whose course the Illinois has occupied.

## Existence of the Upper Valley during Wisconsin Epoch

The upper valley of the Illinois was in existence in the later stages of glaciation. There is varied evidence that the valley is only to a slight extent the work of the recent Outlet River which drained glacial Lake Michigan, and that it was practically at its present depth in the Wisconsin glacial epoch. The evidence may be grouped under the following heads:

[1]Barrows, H. H., The Middle Illinois Valley, Bulletin 15, Illinois State Geol. Survey.

## TILL ON VALLEY FLOOR ABOVE OTTAWA

The accompanying illustrations (figs. 29 and 30) are from the Pioneer clay pits a half mile above East Ottawa, located in the valley between the canal bridge and Illinois River. The base of these sections is less than 30 feet above the present river level. The valley at this point is more than 150 feet deep, so that these pits lie 120 feet or more below the top of the valley. The sections show exposures of till several hundred yards in extent. The till rests upon "Coal Measures" clays and coal and is from 6 to 8 feet thick. Its characteristics are unmistakable: (1) a fresh clay matrix, set with bowlders, (2) many striated, subangular

FIG. 29.—Coal bed buckled by the ice.

stones, (3) "Coal Measures" clays which have been plowed up and greatly disturbed by the ice, and into which was mixed glacial material, and all this buried by distinct till. Figure 29 shows till resting upon a seam of coal, and at one place a small anticline formed by the push of the ice against the coal bed. The fold lies normal to the direction of the valley and shows that the ice at this point was moving in a direction parallel to that of the present valley. The manner in which the shales were plowed up by the ice was discussed in Chapter IV. Figure 30 shows: *A,* till; *B,* small patches of an old soil, fragments of gravel beds which may have come from the river bed, and much "Coal Measures" clay disrupted and mixed in among the body of the till; *C,* crumpled "Coal Measures" clay, and bits of till and isolated bowlders that were pushed into this clay by the ice; and *D*, "Coal Measures" undisturbed at the base. The entire section shows a typical contact of till with a soft underlying formation of bed rock.

The till found in the valley at this point cannot be younger than the Marseilles till sheet, which is the youngest drift in this immediate region. Its occurrence 120 feet below the top of a valley which was cut in solid bed


Fig. 30.—Exposure of till near bottom of Illinois Valley above Ottawa at the Pioneer clay pits: *A*, normal till; *B*, till and disrupted "Coal Measures;" *C*, disturbed "Coal Measures" clays; *D*, undisturbed "Coal Measures."

rock indicates an excavation of the valley to at least four-fifths of its present depth in the Marseilles stage of the Wisconsin glacial epoch, if not at an earlier time.

## GLACIAL GROOVING ON VALLEY FLOOR BELOW OTTAWA

Figures 31 and 32 show the surface of the St. Peter sandstone in Illinois Valley, as uncovered a mile and a half west of Ottawa, at the plant of the Federal Plate Glass Company. About one acre has been stripped of its cover of soil and sand at this place, and the surface of the

FIG. 31.—Waterworn surface of St. Peter sandstone which has been smoothed and grooved by the ice. This view was taken on the property of the Federal Plate Glass Company west of Ottawa on the valley floor of the Illinois.

FIG. 32—Glacially grooved rock surface in Illinois Valley at site of Federal Plate Glass Company west of Ottawa.

rock shows a remarkable number of typical glacial groovings. These vary from mere scratches to channels more than 5 feet deep. Those that show glacial characteristics most plainly are a foot or less in depth. (1) The larger grooves are in general parallel to each other but are not perfectly straight. Some of them, especially the deeper ones, wind considerably. Their general direction is somewhat north of east by south of west, and corresponds to the general direction of the valley. (2) The smaller grooves show a sharply V-shaped cross-section. Water wears rounded, U-shaped depressions; these were chiseled out by the action of ice. Figure 33

FIG. 33.—Typical groove in St. Peter sandstone probably made by water, but the present form is due to glacial action.

shows such a groove from above. The larger grooves do not show this characteristic so well, but are often merely well-smoothed channels Because of their broader floors, they resemble more closely the ordinary water-worn depression. This type is illustrated in figure 31. (3) The sides of the grooves are very smooth and regular. There is none of the irregularity of surface developed by the wear of water due to differing resistances of different parts of the rock, an invariable characteristic of water-worn surfaces of the St. Peter sandstone. (4) Unlike waterworn depressions, these grooves do not slope downstream continuously. Nor do the smaller grooves show any tendency to converge to the larger ones, as do water-made channels. Small grooves may be seen in places upon the sides of larger ones, parallel with them, and, in one case, even upon the crest of one of the knobs (fig. 31).

The winding course and flat bottom of the larger grooves suggest water-made channels, which the ice remodeled by smoothing their sides and deepening their floors. Many of the smaller grooves were cut out entirely by the tools which the ice carried. They are identical with glacial markings found in other places upon the St. Peter sandstone. The elevation of the rock at this place is less than 40 feet above the river level. The conclusion is that ice not later than the Wisconsin grooved the rock in the bottom of the valley when it was almost as low as at present.

## PERU BEDS

West of Peru is a type of stratified drift along the sides of the valley unlike that common at the surface elsewhere. It is shown particularly well along the south side of the valley between Peru and Spring Valley, on all of the lower tributaries west of Cedar Creek and probably also north of the valley on lower Spring Creek. Its distinctive features are (1) its position beneath the Bloomington till; (2) its restriction to a narrow zone marginal to the valley; (3) the weathered condition of its constituents, many of the bowlders being much decayed, the beds as a whole being strikingly yellow due to oxidation; (4) a texture distinctly finer than that of the younger stratified drift which overlies the Peru beds in many places; sand is very prominent and silt almost as common; (5) greater regularity of bedding than in the younger surface gravels; (6) occurrence at lower levels than the latter; (7) the presence of fossils, particularly snail shells, in loess. The buried plant beds of lower Spring Creek are to be correlated with this series in all probability.

General sections typical of the Peru beds are given below:

First ravine west of Cedar Creek, west side of ravine, one-quarter mile above crossing of road, at base of river bluffs:

| | | Thickness *Feet* |
|---|---|---|
| 5. Fresh high-level gravel.................. | | 5–15 |
| 4. Rotted gravels, coarse and fine; sharply separated from 5 by a line of rust which marks the oxidized surface of the older bed........ ................ ........ | Peru beds | 30–40 |
| 3. Loess, surface irregular, thickness regular.. | | 2 |
| 2. Fine gravel and sand.................... | | 15 |
| 1. Clay-silt, dark blue, to base of section..... | | .. |

The lowest western tributary of Cedar Creek intersects the Peru-Granville road about a quarter of a mile south of the river bluffs. Here these yellow sands have been exposed in a large sand pit. In a number of its branches this ravine shows the following relations:

4. Generally at the surface, fresh subangular gravels.
3. Fresh, rather compact, stony, pink till belonging to the Bloomington till sheet.
2. Peru beds; generally sand, typically oxidized, and rotted; water-worn coal, the only material coarser than sand found in these beds (lighter than other rock).
1. Pre-Wisconsin blue till; weathered, deeply cracked and the cracks filled with sand from above.

West of Cedar Creek the Peru beds show an increasing preponderance of silt and clay. In a ravine a mile west of Cedar Creek, clay is underlain by a curious conglomeratic shale. The shale has been former by the cementation of silt, in which are imbedded bits of gravel and fragmentary clam shells. The clay for 40 feet above carries beds that teem with snail shells and vegetable remains. No till is here exposed above the silt. A short distance up the ravine, however, silt of identical characteristics, except for the absence of fossils, underlies the Bloomington till. This silt is of a peculiar drab-blue color, has a very uniform texture, is quite calcareous, grades upward into brownish-yellow sands, and is closely confined to a narrow strip along the river. This phase appears to be the western continuation of the Peru beds.

On lower Spring Creek this blue-gray silt forms the bed of the creek for a considerable distance, and half a mile below Dalzell it is exposed on the right bank of the creek beneath 30 feet of till. The basal part of this section is shown in figure 24. *A*, blue-gray silt; *B*, loess; *C*, till. The number of shells in the silt beds on lower Spring Creek is marvellous. In it are also beds composed very largely of vegetable tissue, well preserved in many places.

The Peru beds underlie the Bloomington till, which is the oldest till of the Wisconsin epoch, and by the manner of their distribution suggest the existence of a pre-Wisconsin drainage line along Illinois Valley below Peru. They have been found to within 50 feet of the bottom of the present valley and appear to agree roughly in distribution with the course of Illinois Valley. The weathered surface of the beds points to their deposition long before the coming of the Wisconsin ice.

## GRAVELS AT BUFFALO ROCK

Buffalo Rock is separated from the northern bluff of the valley by an abandoned channel which once made of the rock an island in Illinois River. This old channel is now followed by the Illinois and Michigan Canal. The present river is able to carry only fine sediment, mostly silt; yet within this old channel there are extensive accumulations of sand and coarse gravel. At the eastern end of the Rock, a gravel pit exposes a dozen feet of very coarse gravel. Just north of its western extremity, about 40 feet above the present river level, a well was sunk through 44 feet of gravel and sand. These materials are exposed also at the west end of Buffalo Rock in the large gravel pit of the interurban railroad. The material is typical of very vigorous drainage, containing many ill-worn stones more than 6 inches in diameter. The last two epochs during which waters having a velocity sufficient to carry such stones flowed down the valley were the Marseilles stage and the end of the Ice Age, when Outlet River drained glacial Lake Michigan through this valley. But Outlet River flowed from a clear body of water, and hence was not laden heavily at the outset with sediment. From the known conditions of the Late Wisconsin valley train above this place, it can be concluded that this river did not excavate a great deal of glacial drift above here. It is not known to have left any appreciable deposits, but it is not impossible that beds of

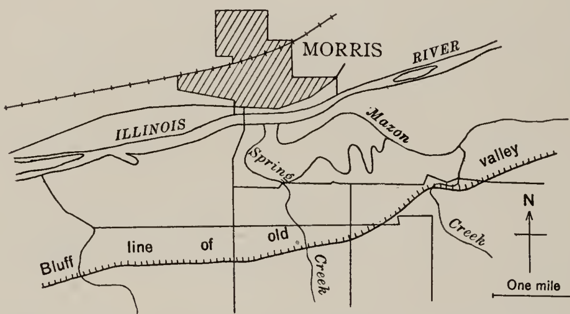


FIG. 34.—Reconstruction of the buried channel of river in the Morris basin.

gravel and sand 40 to 50 feet thick would have been deposited by a stream which eroded as actively as did this river. The likelier view is that these gravels came from the ice while its edge stood at the nearby Marseilles moraine, from which water is known to have carried away much coarse material. The channel in which the gravels lie is almost as low as the present river level. If these beds may be referred to the Marseilles stage, they indicate a minimum age for Illinois Valley similar to that suggested by the till in the valley above Ottawa and by the grooves between Ottawa and Buffalo Rock.

### BURIED CHANNEL OF THE ILLINOIS IN THE MORRIS BASIN

In the Morris basin a similar condition exists. Below the bridge on the ox-bow of lower Mazon Creek, the rock walls of that valley give place abruptly to gentle slopes of loose stratified drift. A section of 30 feet of this stratified material is here shown resting against the steep rock wall of an older channel. This contact marks the place where the Mazon has cut through the old southern slope of the main valley of the Illinois and laid bare an aggraded glacial channel. The base of this section extends to within 10 feet of the present river level (fig. 34). At a point a quarter of a mile farther east a well records a section of 72 feet of sand and fine gravel. This would indicate a buried channel 20 feet lower than the present level of the river. For several miles to the west wells have been sunk to river level through 50 feet of clear sand. North of the river, the presence of a buried channel is shown by a well record from sec. 35, T. 34 N., R. 7. E.

Fig. 35.—Waterlaid sediments of glacial age along Illinois Valley between Marseilles and Seneca. These beds consist mostly of sand and fine gravels overlain by till.

(Saratoga). The top of the well has an elevation of 520 feet. The well is 50 feet deep and passes through sand and gravel only. The bottom of the well is at river level. Other sections on both sides of the river limit these sediments to a zone which follows the valley closely. Their age is Late Wisconsin, and consequently the old river channel through the Morris basin dates from some earlier period.

## KICKAPOO BEDS

On the sides of Illinois Valley between Marseilles and Seneca, are some of the largest gravel pits of the region; some of them may be seen about halfway between the two places along the Rock Island Railroad (fig. 35). These pits belong to a series of stratified beds which are best developed north of the river, particularly about the mouth of North Kickapoo Creek. The most significant points about them are:

1. *Distribution.*—They are confined closely to the valley. Deep ravines that extend back from the river on either side, show that these beds extend but a few hundred yards back from the main valley.

2. *Position beneath till.*—In the pits along North Kickapoo Creek, the gravels are overlain by 10 to 15 feet of Marseilles till. The stratified drift similarly is underlain by an older purplish till, probably of Bloomington age.

3. *Constitution of the beds.*—In the various sections exposed practically every grade of sediment is shown, from fine silt to coarse gravel. The large gravel pits show mostly moderately coarse gravel and sand. Away from the river the material becomes finer. West of the large pits several gullies show a gradation of the material from sand to a fine silt that might pass for loess but for the occasional presence of small bowlders. The gravel is very fresh, shows glacial markings in many places, and was evidently buried by ice shortly after its deposition.

4. *Vertical distribution.*—In the largest pit a section of about 70 feet of stratified material is exposed. This pit extends to within 40 feet of the river level. Half a mile west of Seneca, south of the river, bed rock has been reached in a similar pit only 20 feet above river level.

The Kickapoo beds were deposited by a glacial ancestor of Illinois River during a period when the vigorous stream was supplied with abundant material from the melting ice front. On the margins of the stream, in shallow water, or in the slack water of side streams, beds of silt were laid down. The Kickapoo beds are another indication of the Wisconsin age of the upper Illinois, based on criteria similar to those discussed in the preceding cases.

## OTHER EVIDENCES

The Valparaisio valley train extending down Illinois Valley records its existence at the time of the Valparaiso ice sheet. The gravel filling of Clark's Run at Utica gives similar evidence of an earlier date, as do the high-level gravels paralleling the stream below the Marseilles moraine. All these deposits are described in the latter part of this chapter.

## SUMMARY

The evidence concerning the age of Illinois Valley is distributed from one end of the upper valley to the other. The first locality is in the Morris basin, others lie between Seneca and Marseilles, another above the confluence of the Fox and the Illinois, again below Ottawa, at Buffalo Rock, and finally between Peru and Spring Valley. The records do not all date back equally far. That at Peru is probably the oldest, but this part of the river's course has commonly been thought to be pre-glacial, or at least early glacial. The grooves below Ottawa are apparently of pre-Marseilles age, similarly the till on the valley flat above Ottawa, and the Kickapoo beds. That at Morris is the youngest record. The cumulative evidence points to a valley but slightly shallower than it is at present, when the Wisconsin ice sheets were in the region. With Illinois Valley almost at its present depth in Wisconsin time, the erosion of the major part of the valley falls into the earlier part of the Ice Age.

## Early Wisconsin Period

Probably after Illinois Valley had grown almost to its present size, it was overridden by the ice sheets of the Wisconsin glacial epoch. That part of the valley which was covered by the ice was modified both by glacial erosion and deposition, while the valley beyond the ice front served as a drain for the glacial water, and deposits made by them aggraded its bottom.

### FILLING OF VALLEY BELOW MARSEILLES

### (HIGH-LEVEL GRAVELS)

The extent to which glacial gravels and sands are associated with the upper Illinois Valley indicates the importance of this drainage line during the Ice Age. As the ice advanced and retreated with its front more or less normal to the valley, it follows that unless completely aggraded this valley served as an important line of discharge for the waters issuing from the ice. The high-level gravels along the margin of the Illinois have recorded a part of this drainage history. Especially during the Marseilles stage waters issuing in great quantity from the ice front flowed down the valley. The size of the Marseilles moraine indicates a very considerable halt of the ice front, and the discharge of an immense quantity of sediment-laden water. In this valley, waters from the Marseilles ice front were probably the largest single factor in forming the most extensive beds of stratified material in the upper valley. Deposition seems to have continued until the glacial valley was almost obliterated, and the glacial stream flowed in a broad shallow trough, almost at the level of the prairie. This stratified deposit has been greatly dissected by subsequent erosion and no longer forms a continuous bed. But even before the ice front had receded to the Marseilles position, glacial waters flowed down the western portion of the upper valley and also down the tributaries and caused the deposition of a part of the surface gravels now found at high levels along the valleys. Remnants, however, are sufficiently numerous that their correlation may be attempted. A typical section of these gravels is shown in figure 36. These gravels were deposited in several situations:

Fig. 36.—Gravel pit in ''high-level'' gravels south of Illinois River opposite Spring Valley.

1. *Gravels marginal to the ice front.*—North of the Illinois, Fox River is marginal to the Marseilles moraine. The valley of the Fox has little stratified drift. The drift in this section is distributed as largely over the prairie between Ottawa and Dayton as within the valley proper. The gravels are high above the valley bottom and indicate that the valley in which they were deposited was much shallower than the present valley, which has been cut chiefly since the Marseilles stage. In the recent cutting of Fox Valley, most of the stratified drift left by waters from the Marseilles ice front was destroyed.

Along the western base of the Marseilles moraine and south of the Illinois, gravel is common at least as far south as the headwaters of Covel Creek. The beds were here laid down upon the flat prairie, and average from 2 to 10 feet thick. In the valley of Covel Creek are only a few shallow beds of sand and gravel. It appears that this valley also was developed subsequently to the deposition of the outwash from the Marseilles moraine. On both sides of the river the gravels lap up only for a short distance on the western front of the moraine. The quantity of outwash flanking the moraine is not great, due probably to the lack of adequate drainage lines parallel to its front, and the water spread in a broad sheet over the flat prairie.

2. *Gravels along Illinois Valley.*—In spite of its partial filling, Illinois Valley furnished probably at various times in the latter part of the Ice Age a great drainage line from the ice front, and down it were discharged chiefly the glacial waters with their great loads of sediment. As the bottom of the valley widened, and its grade lessened downstream, the velocity of the water was reduced, and the deposition of large quantities of sand and gravel resulted. These beds now constitute the "high-level" gravels marginal to the Illinois. Their chief characteristics are as follows: (1) They may be traced down the valley at least as far as the Hennepin flat. Their upper limit is the western front of the Marseilles moraine. This distribution points to the Marseilles moraine as at least their partial source. (2) The beds consist almost entirely of gravel, much of which is too coarse to be used for ordinary purposes. Silt is almost entirely lacking, and the sand is coarse. The size of the materials indicates a stream with the velocity of a torrent. (3) A striking characteristic is the grittiness of both sand and gravel. The drift washed out from the ice front was exposed to the action of water only long enough to be sorted into beds of different texture. The materials show but slightly the effect of wear by water and retain, on the whole, the form which they had received in the ice. The stones are subangular and have polished, flattened, and even striated sides. The sand is angular and of plaster grade. (4) The surface of the beds declines gently downstream. From the front of the moraine above Ottawa to Hennepin the decline is not more than 20 feet. The altitude of their surface at Ottawa is somewhat more than 600 feet above tide, and at Hennepin about 580 feet. This makes a surface slope of less than 8 inches to the mile. The position of the tops of the gravel beds approximately at the general level of the upland indicates that filling continued until the valley was virtually obliterated. The gentle slope of the surface of the beds points to their nearby origin. (5) The floor upon which they rest descends downstream much more rapidly. Above Ottawa the base of the gravel has an elevation between 530 to 550 feet, and at Spring Valley 480 feet or less. The amount of filling, therefore, increases greatly downstream. At Ottawa the filling amounts to about 50 feet; at Spring Valley to more than 100 feet.

The most prominent deposits of these gravels are distributed as follows: (1) In the west part of Rutland Township, and south of the river in the west part of Fall River Township. In the former they constitute a small flat which rises more than 100 feet above the river. In the latter, they are near the top of the valley side, generally not less than 80 feet above the river. (2) In the extreme northwestern corner of North Ottawa Township a prominent, isolated gravel knoll, lying between the Fox and the Illinois rivers, shows good sections of these gravels. (3) In South Ottawa Township they underlie the northern half of the southern ward. (4) They are exposed to a depth of 50 feet two miles below the Ottawa bridge. They are horizontally bedded, and their base is at least 70 feet above the present river level.

Figure 37 shows the top of a pit in the St. Peter sandstone, a mile and a half east of Utica opposite Starved Rock. This illustration shows the filling of an old stream bed 160 feet above the present river level, almost up to the level of the riverward margin of the prairie. The section shows:

3. Upland clay, 4 feet.
2. Coarse, well-bedded, and well-sorted gravels.
1. Water-smoothed surface of the St. Peter sandstone, containing irregular channels in which the gravels lie.

Fig. 37.—Surface of valley bluff between Ottawa and Utica. The elevation is about 150 feet above the present river level. The surface of the rock has been smoothed by running water.

From Utica to the eastern line of Utica Township are a series of gravel pits, about 20 to 25 feet deep, distributed along the valley bluffs. South of the river above Utica gravel beds are less common, but there is one on the bluff east of the mouth of Horseshoe Canyon.

In the La Salle region the gravel beds are on both sides of the valley, their surfaces as much as 150 feet above river level, and their bottoms within 40 feet of the river. The gravels are mostly on the south side of the valley. Figure 36 shows a section across the river from Spring Valley.

To the west, they merge into the gravel flat at Hennepin, below the great bend.

3. *Gravel filling of the lower tributaries.*—Practically every tributary of the Illinois below the Marseilles moraine, and particularly below Covel Creek, shows generous gravel filling well above the present level of the streams.

In the valley of Clark's Run, these high-level gravels extend upstream more than a mile from the Illinois bluffs. The filling of this tributary corresponds to the filling of the main valley. Clark's Run shows that at the time its valley was filled, it had at least two-thirds of its present depth, and four-fifths of its present length. Perhaps the comparison of the lower mile of its canyon course, cut in Wisconsin time or earlier, with the quarter mile above cut since, affords a rough means of estimating the age of upper Illinois Valley.

The road north from Utica crosses a small gravel flat, almost at the top of the valley of Clark's Run. This flat is at the cemetery and lies just below the level of the prairie. Upstream sands and gravels mantle the older valley slopes of St. Peter sandstone, as shown in figure 38. Here is a bed of sand 30 feet thick, which extends from the level of the prairie to within 25 feet of the creek bed. These gravels lie hard against a sheer rock wall of which about 25 feet have been exposed in a ravine west of the creek. This rock wall marks the head of the canyon at the time it was filled. Below this point the nearly vertical walls of the run are faced by glacial sands and gravel. Above, to the head of the canyon, the walls of the newly cut, unfilled canyon, are bare, except for a little sand which has slumped down as a result of the weathering of the St. Peter sandstone.

In the valleys of the Vermilion rivers is no recognizable limit of filling upstream. On the Little Vermilion, gravel beds lie near the top of the present valley as far up as the limits of the region covered by this report. In its lower course, the Little Vermilion shows gravel filling on a large scale, chiefly on the east side of the valley. The base of these beds is about 80 feet above the present valley bottom. They are about 30 feet thick and extend upward practically to the level of the upland, or almost to 600 feet. In the limestone gorge of the stream, gravel beds are lacking entirely; but farther up, beds of gravel 5 to 10 feet thick cap the slopes of the valley for miles. These latter, however, may belong to a different series.

The gravels are developed particularly between the German-American Cement Works and a point some distance above Kinder's gravel pit (opposite Fifteenth Street).

| | | Thickness Feet |
|---|---|---|
| 5. | Clay silt, with a few gravel stones | 5 |
| 4. | Gravel, fairly coarse, southward (riverward) dip | 5 |
| 3. | Sand, mostly cross bedded, in places gives way to gravel | 30 |
| 2. | Ill-defined material, probably waterworn | 8–10 |
| 1. | Limestone | 70 |

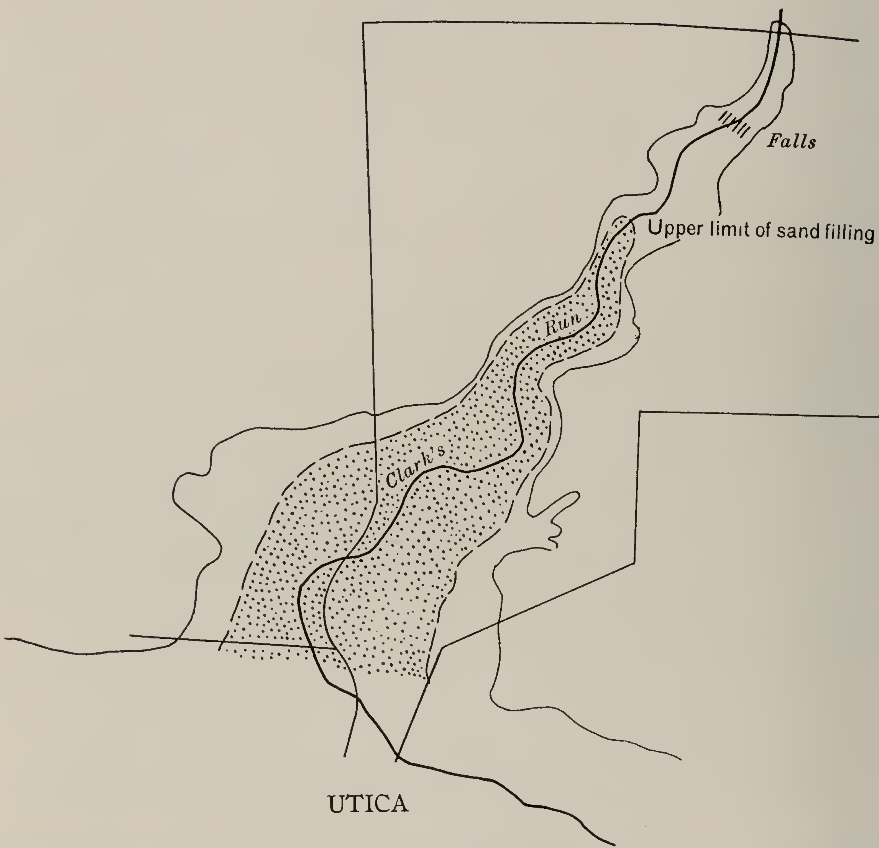


Fig. 38.—Sketch map showing distribution of sands and gravels in valley of Clark's Run.

This section shows particularly: (1) deposition in a shallow valley; (2) almost complete obliteration of this valley by filling; and (3) delta bedding, probably controlled by Illinois River.

The Big Vermilion shows similar gravel beds rising along the lower course of the river to the 600-foot contour line as a maximum elevation, but rising upstream to higher levels. The largest beds of gravel on the lower Big Vermilion are at Mertel's, about two miles below Lowell. Other beds are on the east side of the river, opposite the plant of the Chicago Portland Cement mill.

The filling of the tributaries reaches its greatest development below La Salle. These high-level gravels abound in all the tributaries between Peru and Spring Valley and along Negro Creek, but are found in greatest quantity in the valleys of Cedar and Spring creeks. From their headwaters down almost to their mouths, many of the slopes of these valleys are faced with gravels which rise from an upper limit of 580 feet above tide near Illinois Valley to more than 620 feet on the headwaters of the creeks. On lower Spring Creek the thickness of the gravel reaches almost 100 feet; four miles upstream at Hegler, the thickness is less than 20 feet. Excellent sections, typical of the gravels in the tributaries, are exposed opposite Spring Valley on the east side of the creek, particularly near the Burlington

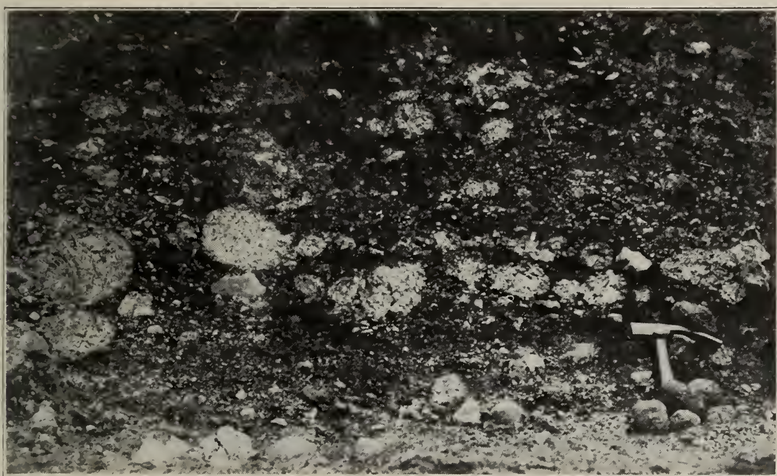

FIG. 39.—Clay balls in the "high-level" gravels.

station. The material is mostly very coarse. Subangular and striated stones are almost as common here as in the till. Although the material was not handled long enough by the streams to show much water wear, it was sorted thoroughly and is well bedded.

An interesting feature to be seen in the gravel of most of the tributaries consists in the so-called "clay balls." These are pieces of till rounded by being rolled by water. They seem to have formed only in very rapid streams and preserved only where speedily covered by other deposits. A vigorous stream, undercutting a frozen till bank, would be especially likely to shape these fragments of till into rounded balls, and then to bury them in the drift which it carried down its course. This feature is illustrated in figure 39 taken from the first ravine west of Cedar Creek, near the head of the ravine.

On Spring Creek near the top of the large gravel sections across from Spring Valley, is a peculiar bed of silt about two feet thick. This bed lies upon coarse gravel and under a thin layer of sand and gravel. It reappears as a gray band near the top of almost every one of the numerous sections on Spring Creek, similarly on Cedar Creek, and on both of the Vermilion rivers. In all these places its character is the same, and it is found in the same relative position in the section, within 5 to 10 feet of the top of the gravel. It is the only bed of silt known in the Marseilles series. It thus forms a convenient means of correlating the gravel beds along the lower tributaries. The silt records a sudden checking of the current of the Illinois, by which the tributaries were correspondingly ponded and were changed from violent streams which had busied themselves with the shifting of gravels, to sluggish waters that formed a layer of fine mud upon their floors.

The various tributaries show a remarkable uniformity of conditions of their marginal high-level gravels. The material in all of them is chiefly coarse, ill-worn gravel, and the beds have a continuous surface slope that joins the surface of the Marseilles beds of the main valley. The position of the beds is also similar to that observed in the main valley. They are clearly considerably younger than the drift which they overlie. As the gravels along the Illinois extend back to the Marseilles moraine, and as these beds along the tributaries show relationship to Illinois Valley in their persistent silt bed, the delta bedding, continuity of slope, and general nature and position of the gravels, the conclusion is that they were formed in large part at the same period and in similar manner. Their flat surfaces, coarseness and unworn condition point to their deposition near the ice front and not to the simultaneous filling of the valley from a distant moraine. The most likely explanation is that the ice receded gradually from its earlier position near Princeton, and filled as it receded the adjacent portion of the Illinois and tributaries. The filling of the upper valley was completed during the building of the Marseilles moraine.

The later scouring out of the main valley by the outlet river left the tributaries practically untouched, so that probably a better record of the filling of the valley during the Marseilles stage is found in the gravel beds of the tributaries than in those of Illinois River.

A side light on the age of Illinois Valley is given by this tributary filling. The existence of practically all of the valleys below Ottawa in pre-Marseilles times, and of some of them, as Clark's Run, Spring Creek, and Cedar Creek, with almost their present length and depth, dwarfs the amount of erosion which has been accomplished since and suggests that most of the excavation of the tributary valleys, as well as of the Illinois, antedates the Marseilles stage.

HENNEPIN FLAT AND SEDIMENTS IN VALLEY OF BUREAU CREEK

Lying in the "Great Bend" of the Illinois, centered about Hennepin, are vast deposits of sand and gravel, forming the Hennepin flat, which lies south and east of the river. It is two miles wide in places and six miles in length. The surface of the flat is about 150 feet above the river level. About Moronts the bottom of the sand and gravel is at least 40 feet below the present bottom of the valley. To the west, about Bureau Junction, the stratified beds are reported to a depth 100 feet below the river, thus making their entire thickness at this point 200 to 250 feet. Illinois River has excavated its present course near the western margin of the older pre-glacial valley with its deep filling of stratified drift. For this reason only remnants of this great deposit of sand and gravel are preserved west of the river and these remnants are along the bluffs of the valley. Almost anywhere on the Hennepin flat, great sections of soft, sliding sand or beds of gravel may be seen. Within this area the roads are heavy in many places because of the deep sand. Crops often burn out from the effects of the summer heat on the sandy soil, which becomes parched readily. Along the small valleys in the Hennepin country, wind-shifted sand is here and there destroying a field or pasture, and in some places wash from sandy gulleys may be seen to have overspread fields of grain.

The materials of the Hennepin flat are, on the whole, considerably finer than those of the "high-level" gravels of the upper valley. Coarse gravels are found in the Hennepin beds, but they are not common, and beds of sand predominate greatly. The stones of the gravel do not as a rule show striae and glaciated surfaces, but are notably rounded by water. The gravel commonly has the appearance of stream pebbles rather than that of glaciated stones, and the sand grains are similarly smoothed and rounded. Because of greater wear by water, these beds lack the desirable grittiness (angularity of grain) of the beds farther upstream. It is not probable that the sands and gravels in the Hennepin flats are all deposits from one ice front, but they may be accounted for in the following manner:

1. *Age of lower beds.*—The lower beds of sand and gravel are in all likelihood much older than the upper parts of the Hennepin flat. The stratified drift in Illinois Valley below the "Great Bend" lies in the great pre-glacial channel down which flowed the waters from melting ice fronts, perhaps even from the beginning of the Ice Age. In the buried course of this pre-glacial valley north of the bend, great accumulations of sand and gravel of pre-Wisconsin age can be traced for many miles beneath the surface till. All the deep wells that have been bored into this buried depression record remarkable thicknesses of stratified drift beneath thick bowlder clay.[3] It is almost certain, therefore, that these older beds of

[3]Leverett, Frank, U. S. Geological Survey Mon. 38, pp. 631-633.

gravel and sand persist below the "Great Bend" in the old river valley.

2. *Stratified drift on Bureau Creek.*—A part of the sand and gravel which was built into the Hennepin flat was furnished by the ice front which made the moraine north of Depue. The principal line of discharge down which the drainage from this ice was swept was probably the depression now occupied by East Bureau Creek with its tributary, Brush Creek. The valleys of both these creeks contain great quantities of stratified drift. This drift covers the slopes and extends considerably below the bottoms of the valleys. On lower Brush Creek, which has its source in the moraine, the gravels form a flat along the western flank of the moraine. In several places, as shown in the following section, these beds are interstratified with till at the margin of the moraine, thus establishing their origin at this source.

*Section on high flat, just below the Ridge School, in gravel pit east of the road*

| | Thickness *Feet* |
|---|---|
| 4. Till, several feet at top of section | .. |
| 3. Fine gravel with much sand | 35 |
| 2. Loamy gravel, poorly assorted | |
| 1. Till | .. |

With one or two exceptions, all the stratified drift on Bureau Creek and its tributaries consists of rather fine material, in which sand predominates over gravel. Large beds of silt are also common.

This source of outwash, close at hand, contributes to the Hennepin area. That this source, however, furnished material to any great extent, appears unlikely, for (1) the Hennepin flat extends some distance to the east of the mouth of Bureau Creek, and well across the moraine at Depue, too far upstream to have been built in its entirety by outwash discharged from Bureau Creek into the valley of the Illinois. (2) The materials of the Hennepin flat are, on the whole, considerably coarser than those along Bureau Creek. Silt and fine sand are the most abundant sediments on Bureau Creek, whereas the Hennepin flat is composed mostly of fine gravel and medium sand. In a stream flowing on an aggraded bed, the ability to carry coarse material decreases downstream, and sediments become correspondingly finer. Finer sediments on Bureau Creek and coarser sediments below in Illinois Valley may point rather to a filling of the Illinois, which ponded the valley of Bureau Creek, and caused the deposition of finer sediments in its retarded waters. Some of the sands in Bureau Valley may well have been deposited in this fashion.

3. *Correlation with "high level" gravels.*—The position of the high-level gravels from Marseilles down to the "Great Bend" of the river, and the similarity of these gravels to the Hennepin beds, point to the Marseilles

ice front and the earlier ice front to the west as the main sources of the materials found in the Hennepin flat. The chain of evidence leads back from Hennepin and Depue to the valley bluffs at Negro Creek and Spring Creek, and thence through the long series of high-level gravel beds, which have been discussed, to the moraine at Marseilles. The material of the Hennepin flat is appropriately finer than the gravels upstream as would be expected of the lessening current downstream. Its waterworn forms bespeak a somewhat distant origin. The great size of the Hennepin flat is explained by the sudden widening of the river valley, which permitted the waters to spread out over a broader surface and caused them to become shallower and lose in velocity. As a result they dropped most of the load which they had carried.

#### PONDING OF MORRIS BASIN

After the ice withdrew, the Marseilles moraine served as a temporary dam for the waters which collected in the valley above it. A lake was thus formed in the Morris basin, in which the bluish-drab lake clays, mentioned in the preceding chapter, were deposited. These clays lie directly upon the older Wisconsin till and are in turn covered usually by thin till of Late Wisconsin age. The clays are 25 feet thick in many places and indicate a rather long-continued ponding of the valley. The Marseilles dam, however, was eroded through before the next advance of the ice, as the sediments deposited by the waters which flowed from the last ice sheet show active drainage down the valley.

### Late Wisconsin Fluvio-glacial Deposits

#### VALLEY TRAIN

The last great sedimentation in the valley was by waters which flowed from the Late Wisconsin ice front. The Morris basin was aggraded heavily by outwash from the ice while its edge stood at the Minooka ridge and later along the Valparaiso moraine. The discharge of the melting waters from this ice sheet was down Illinois Valley, and the sediment-laden stream built a broad alluvial flat which slopes gently downstream. Such a flat built within a valley is known as a *valley train.* It is rather broad and low here with an indefinite extension downstream, but probably no longer recognizable at Marseilles. In the Morris basin the material of the valley train is about 50 to 60 feet thick, at Seneca about 40 feet, and below the latter place it thins out rapidly. In cross-section it forms a wedge of sand and gravel. Its blunt end lies against the moraine, and its thin edge disappears in the vicinity of Marseilles.

In a few places, as on the lower courses of Bill's Run and Mazon Creek, the sands of the valley train may be seen in cross-section. Here they fill the older valley, resting against its sides. The sediments are mostly coarse sands and fine gravel, with an occasional bit of coarser gravel. Upstream the material grows coarser, and sand gives way to gravel generally. Above the Morris basin the valley train is represented chiefly by beds of gravel, which becomes very coarse as the Valparaiso moraine is approached. The materials of the valley train show greater wear by water in the Morris basin and below it than they do above.

### SAND RIDGES

On both sides of the valley train in the Morris basin are low ridges of sand and gravel which lie at some distance from the river. Near the Minooka ridge these sand ridges are about 8 miles apart, but downstream they converge so that they are but 2 miles apart at Stockdale. The area between them is covered entirely by the valley train. These ridges, marginal to the valley train, persist throughout the length of the Morris basin. The one north of the river extends northeastward from Stockdale to the base of the moraine below Minooka; it is followed in part by the so-called "Ridge Road," from Morris to Minooka. At Sand Ridge, the ridge turns south along the base of the Minooka morainic ridge. South of the river, it extends almost due east from a point 1½ miles above the mouth of Waupecan Creek and passes out of this region 1½ miles south of Goose Lake. A generalized cross-section of these ridges is shown in figure 40.

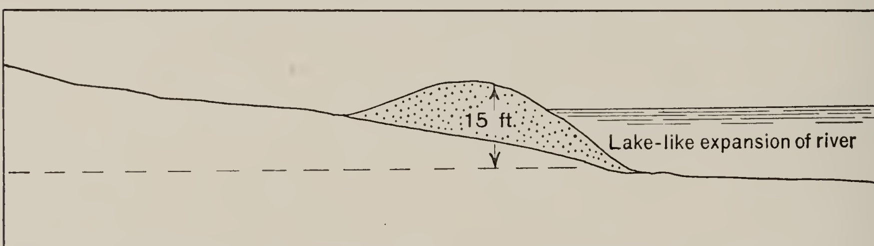


FIG. 40.—Diagrammatic cross-section of a typical beach ridge of the Morris basin.

In many places they show a belt of coarse bowlders along their riverward base. The ridges themselves are generally of coarser material than the rest of the valley train. Their longer slopes face the valley, above which they rise commonly about 20 feet. The crest is generally only from 5 to 8 feet higher than the level of the land behind the ridge.

At first sight they appear to be beach ridges, marginal to an extinct lake. The coarse sand and fine gravel which compose the valley train between the ridges, however, give no evidence of a lake at this time. Nor does the downstream slope of its surface permit any conclusion other than that we have here a stream-built flat and not the level floor of a lake. The sediment in the center of the flat is not markedly finer than that along its margins, as would be the case if it had been deposited in still waters. The sediments within the basin vary greatly and irregularly within short distances; one field may be sandy, the next quite gravelly; the land is said to "lie in strips." All these characteristics are features of river deposition and not of lake work. Rivers ordinarily do not build marginal ridges other than levees, but in the peculiar conditions of the Morris basin they may have done so. The broad, flat basin was sharply constricted below, and a partial ponding of the glacial outwash in the Morris basin resulted. The ridges indicate a width of the stream varying from 5 to 8 miles above Morris and a gradual narrowing to 1½ miles at Seneca. Above Seneca the glacial river was very much like a lake. The slopes of the land on both sides of the river were likewise low, so that the water was well exposed to the sweep of winds from all sides. Large waves could therefore be set up, which were unopposed by any considerable current, and which, in breaking against the banks of the river, could build the low ridges that mark its margins.

### HISTORY OF THE AGGRADATION

The source of the material of the valley train was the ice front at Minooka and later that at Valparaiso. The valley of Au Sable Creek, which is marginal to the front of the Minooka ridge, has beds of sand and gravel, at least as far north as the Kendall County line. Generally these sedimentary deposits along the western base of the moraine are only a few feet thick, but a few beds are of considerable thickness. A knoll of sand and fairly coarse gravel lying just west of the Au Sable, above the mouth of Wallace's Run, contains about 30 feet of sand and gravel over till. Another large knoll of sand lies well up on the flank of the moraine, two miles due west of Minooka, showing a section of 30 feet of sand and coarse silt. These knolls of gravel were probably deposited at the ice front and are known as *kames*. The western flank of the Minooka Ridge is rather sandy in its lower slopes, and the soil is a sandy loam, whereas that on the Minooka ridge is clay. The beds of sand that lie against the Minooka ridge link the valley train of the Morris basin with the Minooka ice front.

Only a small part of the outwash, however, seems to have had its origin at Minooka. Beyond the head of the Illinois, a broad belt of sand and gravel reaches from the southern end of the Minooka ridge to a point a mile south of Goose Lake. These beds extend eastward to the Valparaiso moraine, east of the junction of the Kankakee and Desplaines rivers. They flank the western slope of this moraine for many miles north and south. In Desplaines Valley, and particularly in Dupage Valley, gravels are spread over considerable areas. In these valleys the outwash has two especially noteworthy features: (1) It becomes decidedly coarser upstream, gravels taking the place almost entirely of sand and silt, and (2) the surface of the beds rises rapidly upstream. In the Morris basin, the surface of the valley train is at about 530 to 540 feet about tide; about Channahon, at the mouth of the Dupage, it is more than 570 feet. Figure 41 shows a section of these gravels half a mile east of Channahon, on the divide between the Dupage and the Desplaines rivers. Practically the entire area between the lower courses of these rivers is covered with these gravels. The country about Channahon is as typically a gravel country as that about Morris is

Fig. 41.—Recent fluvio-glacial gravels east of Channahon on the divide between the Dupage and Desplaines valleys.

a sandy region. East of the Desplaines, at Drummond, a large isolated knoll shows conspicuously bedded gravels on the smoothed rock surface; this knoll lies at the very base of the Valparaiso moraine, and connects the valley train at this point with the Valparaiso moraine. These gravel beds extend up Desplaines Valley beyond Joliet and Lockport. Here the elevation of their surfaces is well above 600 feet, and the material is very coarse and ill-worn.[4]

### TRIBUTARY FILLING

While the upper Illinois was being aggraded by outwash from the Late Wisconsin ice, its tributaries were ponded by the swollen main

[4]Goldthwaite, Illinois Geol. Survey Bull. 11, pp. 49-52.

stream and partially filled. Tributary valley fillings are a persistent feature throughout the Morris basin. The main stream had a sluggish current and deposited sands chiefly; the retarded tributaries, correspondingly, filled in their valleys with silt. Nettle Creek Valley was aggraded at least 40 feet in its lower and middle course. Its valley is still heavily filled, the post-glacial stream having merely re-excavated a channel to about the depth of the former channel. Mazon Creek shows also valley filling, and its slopes are heavily mantled with silt.

### CONCENTRATION OF BOWLDERS

Bowlders are found in only a few places in the Morris flat. They are rather abundant (1) at the base of the ridges marginal to the valley train, and (2) near the head of the Illinois, especially west of the tracks of the Elgin, Joliet, and Eastern Railroad. The coarse material along the former margins of the river may have been left by undercutting of its bank, in which the finer material was washed away, or waves may have helped to roll them up from the floor of the river, or ice blocks may have become stranded on the banks and dropped their bowlders as they melted. At the head of the Illinois the waters which swept down from the steeper slopes above spread out over the broad, shallow Morris basin, and ice blocks which were carried down may have become grounded with their load of bowlders. Much of the coarse material at the head of the Illinois probably has come from the erosion of the southern end of the Minooka ridge by the Outlet River.

### SUMMARY

The extension of the late Wisconsin ice to Minooka, and more especially its halt along the Valparaiso moraine, was accompanied by a great outflow of debris-laden waters from the ice front. These flowed through depressions marginal to the ice, as Au Sable Valley, and later reached the valley of the Illinois itself. Gravels were deposited above Channahon, sand and gravel in the Morris flat. Below Seneca the valley train plays out gradually. Sections of sand of 70 feet and over and heavily aggraded tributaries record the great extent of deposition in the Morris basin during this stage. Because of its lesser age, the record is much less obscured than that of the older drainage of the western part of the valley.

## Outlet River

After the building of the Valparaiso moraine, the ice retreated gradually northward and northeastward, rallying once, and finally withdrawing completely from the region. As the ice melted back from the Valparaiso moraine, its waters no longer found free drainage down Illinois

Valley, but were ponded behind this great till ridge and other deposits of till to the north. The lake thus formed is known as Lake Chicago, ancestor of the present Lake Michigan. The ponded waters rose gradually until they overflowed depressions in the retaining wall of drift above Lemont, and eroded the outlet which they had discovered. For a long time the glacial lake drained westward into the valley now occupied by the Desplaines, and thence into the Illinois, by means of this so-called Outlet River.

Locally, erosion by Outlet River was not great. The glacial stream inherited a valley, whose rock floor appears to have been essentially as deep as at present, but which had been aggraded considerably by outwash from the Valparaiso moraine. Outlet River may have lowered the valley from the 40-foot terrace, which is common to most parts of the upper valley, to the present level of its channel. In the Morris basin this terrace is ill-defined, but is probably represented by the level of the surface of the late Wisconsin valley train. Farther down the valley, at least as far as the western limits of the area, is a terrace at about the same level, on rock, covered with sand or gravel, and interrupted occasionally by old stream channels. This 40-foot terrace may have been developed by aggradation by Minooka-Valparaiso outwash, and by side cutting of its meandering stream. There is no reason to believe that Outlet River did more than lower the valley of the Illinois from the 40-foot terrace, and it may have done considerably less. The greatest part of its work has consisted certainly in clearing out the Late Wisconsin valley train, and even of this it has left the greater part untouched. Although a great volume of water swept down the Illinois from glacial Lake Chicago, it may not have been of much greater volume than the glacial streams issuing at other periods from various ice fronts which were thrown across the valley and discharged their outwash down the Illinois. Outlet River was one of the last brief phenomena of the rapidly dying period of glaciation, and its role in upper Illinois Valley was not of the order of importance which has generally been ascribed to it.

In its continued retreat northward, the ice uncovered several lines of discharge for the lakes at its margins lower than that taken by Outlet River. One of these was the Mohawk depression in New York, now followed by the Erie Canal. Later the present valley of the St. Lawrence was uncovered. Thus the outflow was diverted from Illinois Valley, and modern Illinois River was formed by the collected run-off of the intermorainic troughs of the Late Wisconsin drift, namely the valleys of the Kankakee, Desplaines, and Dupage rivers. Recently, man has re-established the old drainage line by cutting the Chicago Ship and Drainage Canal through the low divide, so that water from Lake Michigan again flows into the Illinois, and thence into the Mississippi. Interesting estimates have been made, which show that, with a continuation of the upwarping of the northeastern part of our continent, now going on, the western Great Lakes may be cut off from their eastern drainage line in the course of several thousand years and may discharge again through their abandoned glacial channel into Illinois River.

# CHAPTER VI—PRESENT ACTIVE PHYSIOGRAPHIC PROCESSES

## Work of Wind

### CHARACTERISTICS OF DEPOSIT

Strong winds are able to shift about much sand and dust, especially if there is no protecting cover of vegetation. Immediately after the close of the Ice Age, before vegetation has established itself upon the surface of the drift, the wind was peculiarly effective in forming loess or dust deposits, and sand dunes. Recently, since the general cultivation of the land, the soil particles have again been exposed extensively to the sweep of the winds, with the result that much dust is again blown about in dry weather. Wind-made deposits show no definite limits, either vertically or horizontally, nor is there commonly any regularity in their thicknesses.

### MAKING OF DUNES

Mention was made in the preceding chapter of the great deposits of sand, silt, and gravel which formed in Illinois Valley during the Ice Age. Sand and silt predominated especially about Hennepin and in the Morris basin, and in these two sections the wind found an exceptionally favorable field for activity. Where sand was exposed abundantly at the surface, and the wind had an effective sweep, dunes were formed near the source of supply. At greater distances the wind spread out thin deposits of sand in irregular sheets.

About Hennepin the wind (1) piled up much sand into dunes on the flat, and (2) spread a veneer of sand over the upland to the east of the flat. Both features are well shown about Moronts, which lies on the border between the flat and the till upland. There are numerous dunes on the flat, and on the margin of the prairie sand is heaped into small dunes three to five feet high. Eastward, the sand becomes thinner and grades into buff, sandy loess. This sand- and loess-covered belt of prairie marginal to the Hennepin flat is about three miles wide. The gradation from coarse dune sand near the flat to fine loess on its eastern margin is regular, and is an expression of the distance the material was carried.

Upon Buffalo Rock near its western end, are several mounds of sand, 10 to 15 feet high. In their present form, at least, the hills are wind made. Again, south of the river and west of Covel Creek are low rock-knobs upon the river terrace. The terrace has an almost universal cover of gravels and of very coarse sand. These knobs of rock, however, are veneered with sand which the wind spread over them and so gave to them the appearance of dunes.

The most conspicuous sand hills of the region are in the Morris basin. Here an abundance of material was furnished by the fine outwash from the late Wisconsin ice. All along this part of the valley the sand of the valley train has been heaped into unstable hills, which creep out over fields or fill roads with sand, five to six inches deep. Of the many low knolls in the Morris basin only a few, however, are dunes. Many are knolls of gravel or rock that are merely surfaced with sand. The largest dunes are those of Sand Ridge at the base of the Minooka Ridge. Here are a number of elongated hills of loose yellow sand, which once formed part of the northern "beach ridge" of the Illinois. They are from 50 to 180 yards wide and extend in a curving and interrupted series for a mile on both sides of the Sand Ridge station. This wave-formed ridge was worked over gradually by the wind and heaped into a chain of hills, between which the wind scoured out the sand and thus interrupted its continuity.

### SHIFTING OF DUST

Far more dust than sand is blown about by the wind, because the dust particles are smaller and expose a relatively greater surface to wind pressure. This phase of wind work is not nearly so apparent, however, because dust is moved so readily that it is not generally lodged in well-defined heaps. Dust is on almost every dry surface and is carried by almost every air current. The upland clay which overlies the drift in much of the region may be in part a wind deposit blown up from the dried silts of the glacial outwash. It is also in part of subsequent accumulation, almost constant contributions having been made by the winds, particularly by the dry winds of spring and summer. The quantity of dust which winds may whirl over the prairie is well illustrated by almost any dry, windy day. Air currents may then be seen whipping up clouds of dust from the dry fields and sending them flying over the prairie surface, until the gust is spent or some obstruction catches the dust.

## Work of Ground Water

### SPRINGS AND WELLS

It is estimated that about half the rain which falls on this country is evaporated and restored to the atmosphere; about one-third runs off; and the remainder sinks into the ground, there forming a subterranean reservoir known as the ground water.[1] The water which sinks beneath the surface is stored in the pore spaces in the rock or drift and flows under action of gravity, as surface water does, though far more slowly. Where the pore spaces are large, it moves more readily than where the texture is fine. Porous beds, if underlain by an impervious layer that does not allow the

[1]McGee, W. J., Report National Conservation Commission, vol. 1, p. 39.

water to pass through, become reservoirs for the surface water that seeps into them and are then called ''water veins.'' If a porous, water-filled bed outcrops on a slope, it may give rise to springs.

South of Spring Valley springs are common on the slopes of Illinois Valley. Most of them are formed by gravel beds that overlie impervious ''cement rock'' (conglomerate formed by the cementation of glacial gravel). In many places in the till, patches or pockets of gravel furnish water; most of the shallow wells of the prairie derive their supply from gravel lenses that lie beneath the surface. The depth of the wells varies greatly and irregularly, and is due to the irregular and discontinuous distribution of the lenses of gravel. In cuts stratified material which is interbedded with till may generally be distinguished at a distance by its moist surface. In the ''Coal Measures,'' the porous sandstone beds furnish considerable water. The St. Peter sandstone has the Prairie du Chien limestone as an impervious base; this combination makes the St. Peter sandstone the most important water-bearing formation of the region.

The upper surface of the ground water (the water table) is generally some distance beneath the surface of the ground. Rains replenish the ground water. When rains are heavy they may raise the level of the ground water nearly or quite to the surface of the ground. If the rainfall is deficient, evaporation and seepage may cause the ground-water level to sink many feet. The more porous the soil, the more will the surface of the ground water vary. The stiff clay soil of this region retards evaporation and seepage so that in most places prairie wells no more than 20 feet deep do not go dry even in seasons of deficient rain. Similarly, most prairie-fed streams have a rather constant flow, being supplied by dependable springs wherever their channels are below the ground-water level. On the other hand, in the gravel country of Putnam and Bureau counties evaporation from the soil is much more rapid because of its high porosity, and the ground water nearly or quite to the surface of the ground. If the rain-Creek, Putnam County, is comparable in depth and width to most of the prairie streams, yet it is dry during the summer and fall, except after rains. Streams to the east that flow through till, although much smaller than this one, have permanent streams.

Flowing wells are numerous in the lowlands of this region. Flowing water may be secured almost anywhere in the valleys of the Illinois and the Fox and generally in the Morris basin. Most of the artesion wells are drilled into the St. Peter sandstone, but flowing wells have been secured in every sufficiently porous formation underlying the region from the Potsdam to the ''Coal Measures'' sandstones. Any given formation lies considerably deeper west of the anticline than east of it, so that wells must be drilled deeper in the western region to reach water-bearing horizons.

Shallow wells of strong flow are numerous in the eastern half of the valley, which is underlain at slight depths by the St. Peter sandstone.

The water in an artesion well flows out under pressure similar to that of a stand-pipe. The water-bearing beds outcrop to the north over wide areas at considerably higher elevations. Great quantities of water are collected in these regions, especially in Wisconsin, and carried underground by the southward dip of the beds. The water moves down the dip, comes under constantly greater head, and when released from this pressure flows forth with considerable force (fig. 42).

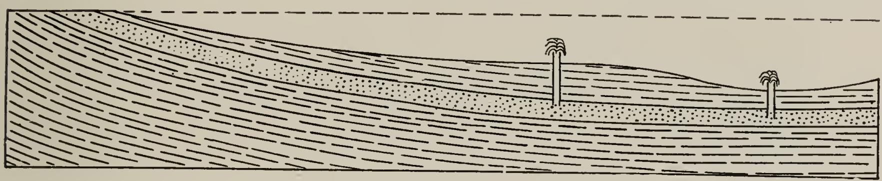

Fig. 42.—Diagrammatic illustration of conditions favorable to artesian wells.

SOLUTION AND REDEPOSITION

Ground water is much more active chemically than the run-off. Ground water moves under pressure which increases its dissolving power, and it comes in contact with a greater area of rock surface in its interstitial wanderings than does surface water. It thus has excellent opportunities to take mineral matter into solution. It is especially active in leaching soluble materials from the surface zone. Among its most abundant constituents is lime carbonate, which may be leached out almost entirely from the upper two feet of the soil. The depth of leaching furnishes a means of estimating the relative lengths of time during which the surface tills have been exposed. About Minooka the calcium carbonate has been removed only to a slight extent; west of the Marseilles moraine the surface clay has been leached for several feet; farther south the tills of central and southern Illinois have been leached so deeply as to impair seriously the fertility of the soils.

With increasing depth the waters become increasingly charged with mineral matter which they have taken into solution. The water of the shallow wells is only moderately "hard;" the deeper wells of the region have highly mineralized waters. Those of the "Coal Measures" are generally salty or bitter, and those of the St. Peter sandstone are known favorably to health seekers for their charge of sulphureted hydrogen.

The dissolved materials are commonly deposited again, either by evaporation as the water seeps to the surface, or by chemical precipitation which takes place where waters charged with different chemical compounds mingle, or when a decrease of pressure reduces the ability of the water to hold material in solution. Ground water on evaporation at the surface may leave its mineral material behind in the form of an efflorescence. Figure 43 shows an efflorescence of yellow and white clusters of a variety of salts. Till is tinged white in places by incrustations of calcium carbonate formed in the evaporation of its ground water.

Concretions are formed by ground water in the manner noted in Chapter III. The process is still going on in many places. Concretions may be seen forming, particularly in glacial clays, and also in various

FIG. 43.—Incrustation of various mineral salts on the surface of ''Coal Measures'' shales. The salts are being deposited by the evaporation of the ground water as it seeps to the surface.

glacial gravel beds. The high-level gravels show, in many places, concretions of iron carbonate, built up of thin concentric layers. The loess of the region, contrary to its general custom, carries few concretions.

The ''cement beds'' found in the stratified drift are an excellent illustration of deposition by ground water. These beds are best developed in the ''high-level'' gravels (fig. 44). They are most commonly found at the base of the gravel, but may constitute a series of beds at various horizons in a gravel pit. The chief cementing material is calcium carbonate, derived by solution from the abundant limestone in the drift. Cementation has been so complete in many cases, that the conglomerate fractures across the pebbles instead of around them, thus showing that the cement is stronger than the materials cemented. Less common than conglomerates are sandstones of post-glacial origin; such beds are found in the Hennepin region. Shales formed by the cementation of glacial silt, lie at the base of the Peru beds. These various cemented beds are at the contact of two beds of different textures; this may be either at the contact of different beds of stratified drift, or at the contact of stratified drift and till. In any case, the cementation is due to a change in the circulation of the ground water, which caused

FIG. 44.—Cemented gravels of glacial origin in a pit south of Spring Valley. These "cement beds" are common features of the glacial gravels of the region and are in many places very hard conglomerates.

the deposition of part of the material in solution as a coating on the walls of its pore spaces, until they were gradually filled.

## WEATHERING

Weathering is the slow, unobtrusive disintegration of rocks by the chemical action of air, by ground water, by changes of temperature, by plants, and other agents. The weathering of rock gives rise to soil, and also prepares the surface materials for erosion and transportation. The process is going on everywhere at the surface of the earth. On slopes the weathered material becomes lubricated by water from rains and creeps slowly down hill under the pull of gravity. Large masses that slide down suddenly are then said to have slumped; such slump masses are common locally on all steep-sided till valleys. Trees and bushes carried down in these miniature land slides are tilted and betray the occurrence of such a slide. By starting material on its way toward streams, creep and slump are early steps in erosion.

In the weathering of firm rock certain characteristic features are developed. Most of the bowlders now exposed at the surface do not show striae or planed faces, although they were glaciated. The surface parts of exposed bowlders are generally scaling off, whereas the body of the rock remains undecomposed. This scaling off, or *exfoliation,* is due to the greater

Fig. 45.—Igneous bowlder containing large crystals that have resisted weathering more successfully than the ground mass of the rock, and hence stand out in relief.

heating of the exterior of the rock by day and its greater cooling by night. Expansion and contraction due to changes of temperature are greater in the outershell than within, strains are set up between the outer shell and the inner body, and exfoliation results.

Some part of a given rock may weather more rapidly than the rest of it, so that an uneven surface will be developed by continued weathering. Illustrations of this are shown in figures 19 and 45. In the former, small veins stand out as ridges in the rock, because of their superior resistance to weathering; in the latter, the large crystals stand out in relief from the ground mass of the rock for the same reason.

Numerous other effects of weathering might be mentioned. It suffices to say, however, that all the obscure processes grouped together under this name, tend to increase gradually the quantity of the soil.

## Work of Streams

### DEVELOPMENT OF VALLEYS

#### ORIGINAL POST-GLACIAL SURFACE

The ice, especially by its deposits, destroyed most of the pre-glacial drainage lines and left an uneven surface marked by slight elevations with

Fig. 46.—Very recent gully in pasture on Kickapoo Creek.

intervening discontinuous depressions. Illinois Valley and most of its larger tributaries were in existence at the close of the Ice Age and have only been deepened since. The smaller valleys, however, are chiefly the product of post-glacial erosion. The steps in their formation are outlined below:

#### GROWTH OF GULLIES

In the first stages of its development a valley is called a gully. Such valleys in extreme youth may be seen almost anywhere in the region, especially on the slopes of the larger valleys. Figure 46 shows a gully starting on a hillside pasture, and figure 47 shows a ravine (a gully growing up) of somewhat greater age. The latter figure shows the steep slopes characteristic of ravines and young valleys, slopes commonly as steep as the material of which they are composed will allow. The V-shaped cross-section of young valleys is also well shown in this illustration. Other features which are characteristic of youthful valleys are great depth of valley relative to width, and steep grade of the channel.

Fig. 47.—Cross-section of a young, V-shaped valley south of Marseilles.

Gullies may develop on all land surfaces sufficiently elevated for erosion by running water. (1) If the land is slightly uneven, as most land is, any depression will collect more water than the surface about it, and if it has an outlet, it will be deepened by the running water. (2) At one place the soil or rock at the surface may be less resistant than at others, and consequently will erode more rapidly. (3) By the destruction of a protecting cover of vegetation the soil may be exposed to erosion. Apparently trifling causes may then lead to the development of destructive gullies.

A gully once started is enlarged by the run-off of each successive shower; each enlargement causes it to gather more water, so that growth once begun continues at an increasing rate. The bed of the gully is worn down more rapidly than its sides because more water flows over it. As long as the bed is lowered more rapidly than the sides are worn back, the valley remains steepsided and narrow. While the sides are being worn back and the bed lowered, the head of the gully is also being cut back, and it is therefore lengthened. In its youth, a valley generally grows faster in length and depth than in width.

When a gully has become more than a few rods long, or a few yards wide, it is commonly called a ravine. When its bed is lowered to the surface of the ground water, it no longer depends solely upon rains for water, but seepage from the ground water enters the valley and forms a more or less permanent stream. As the ravine grows, small gullies are started on its slopes, and so on until an endlessly branching drainage system is developed.

As valleys which have had but short histories are called youthful, so a region which has been furrowed but slightly by valleys is said to have a youthful topography. This is the character of most of the prairie of this region, whose surface is essentially as it was left by the ice. Only a few streams have notched its surface, and the upper courses of most of the streams of the region have no valleys of their own, but follow chains of shallow depressions in the drift of the prairie. Except in the zone immediately bordering the river, the dissection of the surface of the prairie has scarcely begun.

### DEVELOPMENT OF VALLEY FLATS

As erosion continues, the rate at which the valley is lengthened and deepened decreases, and the time comes when growth in these directions ceases entirely. But the widening of a valley does not cease. When the head of a valley has worked back to the edge of another drainage basin, the valley may cease to grow in length. In other words, a permanent divide becomes established. Similarly the deeping of the channel ceases when the gradient of the stream has been so reduced that the sluggish stream can no longer wear its bottom deeper. But long after the stream has ceased to grow in length and depth, its sides are still being worn back by slope wash and side cutting.

A stream that has so reduced its current that it is unable to erode its bed further is said to be *at grade.* A stream at this stage is able still to undercut its banks and widen the bottom of its valley. A flat is thus gradually developed by side cutting, and upon this floor the stream deposits in time of flood the sediments which its upper water and tributary streams have contributed. The flat which the stream covers in time of flood is called a *flood plain.* A stream which has built an extensive flood plain is said to be *mature.* The older the stream is, topographically speaking, the wider is its flood plain. A mature stream has a sluggish current, and is easily deflected from its course by obstructions in its channel. Except in times of flood, it wanders about feebly, and may be deflected by any obstruction against which it flows. Under these conditions it swings back and forth across its flat in an ever-widening series of bends, called *meanders*. At the outer edge of these bends it may undercut its bluffs and so maintain steep valley sides. Meanders are characteristic of all depositing streams and are well shown in Illinois Valley below Peru.

### STAGES OF VALLEY DEVELOPMENT IN THIS REGION

All stages of topographic development may be shown by a single valley. The lower course may be in old age, while its headwaters and the upper courses of its tributaries may be in extreme youth. This condition is true of the Mississippi system and in a less complete way of the Illinois.

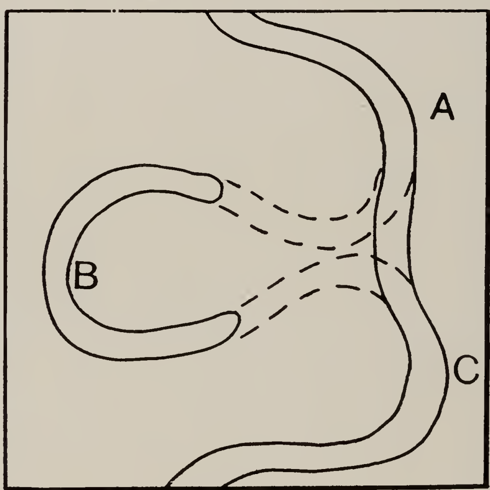


FIG. 48.—Diagrammatic illustration of the formation of an ox-bow lake.

The upper Illinois basin contains all gradations from gullies that are just started, to Illinois Valley, which below Peru, is well along in maturity.

Illinois Valley itself shows various stages of development in its various parts. Below the Vermilion rivers, it has developed a flood plain a mile wide, and the sluggish stream meanders in the valley with a gradient so low that erosion has practically ceased (see cross-section at Peru, figure 5). Above, the valley is in a much earlier stage of development and has not yet destroyed a series of rapids formed by beds of hard rock in its channel. On its lower course the meanders of the river carry it from one side of the valley to the other, and on the flood plain are numerous ox-bow lakes. They are remnants of old stream meanders which were abandoned and partially silted up as the stream shortened its course in breaking through the narrowed neck of a meander, as shown at A, figure 48. Figure 49 illustrates the gradual destruction of such a stagnant pool. (1) Swamp vegetation rapidly encroaches upon their borders and helps to fill them with its dead leaves and stems; (2) spring floods leave some sediment in overflowing these sloughs; (3) finally, wash from the sides helps in their obliteration. Their destruction is rapid, and a decrease in their size may be noted in some cases in a few years. Some of the older maps of the region show cut-off lakes on the flood plain below Spring Valley which are much larger than at present. Lake Depue, one of the largest of these cut-off lakes, is maintained

Fig. 49.—Stagnant pool gradually being filled by vegetation.

by springs which issue on its floor. As is often the case with mature and adolescent streams, the sides of the Illinois Valley are in general steep. This is due chiefly to undercutting.

Most of the larger tributaries have developed valley flats in their lower courses. This is true especially of the western tributaries. Spring Creek, Bureau Creek, and even Cedar Creek have broad flats. Within each of these valleys, the flood plains afford room for cultivated fields. Farther east the valleys are chiefly narrow and deep, in many cases canyon-like.

### ADJUSTMENT OF TRIBUTARIES

Adjustment of the lower courses of tributaries to the changes of the main channel have been rather common in this region. The lowest tributary of Fox River from the east flows toward the Illinois until it reaches the valley of the latter. It then turns west along the northern margin of Illinois Valley and joins the Fox at the point where the latter enters the broad terrace of the Illinois. The lower part of this tributary occupies an abandoned channel of Illinois River. The Illinois now flows along the

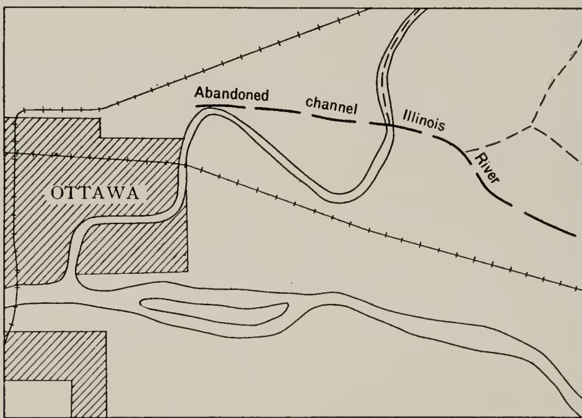


Fig. 50.—Sketch map showing the relation of the lowest tributary of Fox River to the abandoned channel of Illinois River.

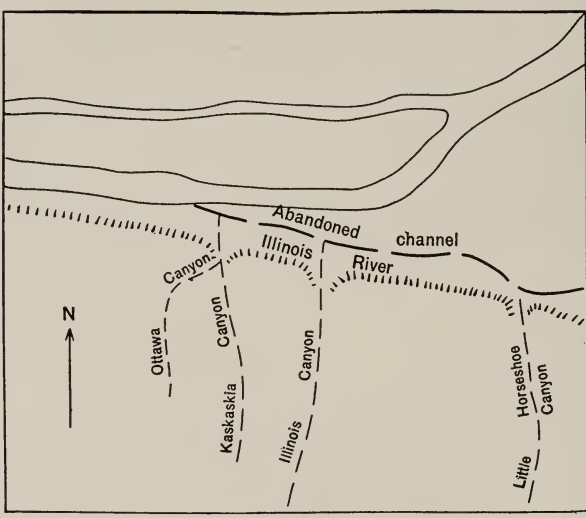


Fig. 51.—Sketch map showing the relation of some of the tributaries of the Illinois at Starved Rock to the abandoned channel of Illinois River.

southern margin of its valley, and the Fox has extended its course south across the old channel to join the shifted Illinois River, while the small tributary has fallen heir to the abandoned channel of the main stream, but in so doing has shifted its mouth from the Illinois to the Fox. The relation is shown in figure 50.

Between Starved Rock and South Ottawa a similar feature is shown (figure 51). Three ravines are cut into the southern bluff of Illinois Valley. As the first stream reaches the flat of the Illinois, it turns sharply westward parallel to the river. It is joined by the middle tributary, and only after the third stream is added does the composite stream turn to join the Illinois. The united stream occupies an old channel of the river that enters the present channel below the mouth of the third ravine. The tributaries, because of their occupation of this deserted channel, now form one stream, although their development was independent of each other, and their union dates only from the time of the change in the channel of the Illinois.

## SPECIAL DEPOSITIONAL FEATURES

### CONDITIONS OF DEPOSITION

Deposition takes place whenever the velocity of a sediment-bearing stream is sufficiently retarded. Such a condition occurs most commonly by a decrease of gradient or by a loss of volume of water. When the velocity of a stream decreases gradually downstream, it drops its load little by little and develops a gently sloping flood plain. When the flow of a stream is checked suddenly, it drops most of its sediment within a very short distance. There are then formed deltas, sand bars, and alluvial fans.

### DELTAS AND SAND BARS

The current of a stream is checked when it flows into a body of standing water, as a lake, or when it joins a stream more sluggish than itself. The stream thus retarded will drop most of its load promptly in a small area rather than distribute it slowly over a broad area, as is the case if retardation is gradual. In standing water such deposits make a delta. At present there is no body of standing water within the region to supply perfect conditions for delta formation. Illinois River, with its sluggish current, serves to some extent as such a body for its more rapid tributaries; several of them have made large deposits of sand at their mouths. The Vermilion rivers and Spring Creek, for example, have formed large bars at their mouths, and in time of low water these bars often become serious impediments to navigation. Although not true deltas, their mode of origin is similar, and with a lesser current of the Illinois they would have developed into normal deltas.

### ALLUVIAL FANS

Alluvial fans are fan-shaped bodies of alluvial material resting against the base of a slope. They are somewhat similar to deltas, except that they were deposited on land. They are composed of silt, sand, or gravel which has been washed down a slope by rivulets and deposited at its base. The bottom of a steep slope at the base of which is a flat plain is especially favorable for the development of alluvial fans. The water which flows down the steep slope is able to move much sediment, but is unable to carry it when it spreads out over the flat below, so the load is dropped somewhat promptly, though less promptly than in standing water. Conditions favorable for the formation of such fans are found particularly on the outer side of the ''Great Bend'' of Illinois Valley below Depue. Here is a great abundance of loose sand along the side of the valley. The slopes have been made steep recently by the undercutting of the river, and a broad flood plain adjoins the bluffs. Numerous gullies have been cut in the sandy bluffs, and their wash is deposited upon the flood plain in well-developed alluvial fans of loose sand. This condition is illustrated in figure 52.

Fig. 52.—Small alluvial fan.

## INFLUENCE OF MATERIAL UPON TOPOGRAPHY

### BED ROCK

The individuality of erosion features, such as hills or valleys, depends largely upon the kind of material in which they have been formed. Valleys of similar age and with streams of similar volume may differ widely in their topographic character, because cut in different material. Not only will valleys cut in bed rock and valleys cut in drift show different characteristics, but valleys cut in different kinds of bed rock differ, as do valleys cut in different kinds of drift.

The character of the valleys cut in rock is dependent both upon the composition and the hardness of the rock and upon its structure. Abundant

FIG. 53.—Lower Falls in Deer Park Glen; a canyon in St. Peter sandstone (photo by Rhodes.)

illustrations of the varying resistance of bed rock and drift to erosion are furnished by the valleys of this region.

1. The *Prairie du Chien limestone* is extremely resistant to erosive processes. Where it outcrops in Illinois Valley, the river has not been able to wear it down to flood level in all places and numerous low knobs of it are left on the alluvial lowland. In the upland back of Pecumsaugan Creek it outcrops similarly in irregular elevations above the general surface of the prairie. Valleys cut in the formation develop almost vertical cliff faces. The valley of Pecumsaugan Creek, cut in the Prairie du Chien limestone for more than a mile north of the canal, has developed a gorge more than 80 feet deep. The other valleys in this limestone are short ravines, but they are all narrow and steep sided. Where the Tomahawk and Little Vermilion creeks cross this formation similar cliffs are developed.

2. In the *St. Peter sandstone* still more pronounced gorges are developed. Several of them in the Starved Rock region are illustrated in figures 9 and 53. These canyons are commonly not more than a hundred feet wide at their tops, and may be as deep or even deeper. Their sides are vertical, and in many places the cliffs overhang. The canyons end above in blunt heads, over which water comes tumbling from the shallow draws of the prairie above. Most of the falls at the heads of the canyons are fifty feet or somewhat less in height.

The St. Peter sandstone is a relatively soft formation and erodes very readily, so that streams soon develop flats in their valleys. The canyon-like character of the valleys in this formation is due to the presence of a harder cap rock above the body of the St. Peter. Most of the formation consists of slightly cemented sand, in which wide, gently sloping valleys would be readily formed . Its top, however, has been cemented more firmly than the rest of the formation. In some places, as in Deer Park Glen, the sandstone is overlain by a hard capping of Platteville limestone, and in many other places by the resistant basal sandstone of the "Coal Measures." Nearly everywhere in this region, one or the other of these hard beds caps the formation. This cap rock weathers back more slowly than the softer sandstone beneath it. Since the lower beds weather out more rapidly than the capping bed, the sides are always either vertical, or the cap rock overhangs the lower slope of the valley. In some places the overhang is so great, that the canyons appear bottle-shaped in cross-section. The rate of weathering of the resistant cap controls largely the rate at which the valley widens.

A cliff of the St. Peter formation is shown in figure 54. The numerous cup-like depressions in the sides appear at first to be the remnants of a vertical series of pot-holes; but they are mostly the result of the differential weathering of harder and softer beds of the sandstone. The depressions lie both in horizontal and vertical series. Their horizontal alignment is due to the weathering out of a softer bed between harder layers. Their vertical development is generally along joint planes that form lines of weakness, along which weathering or erosion is most rapid. Jointing has also given direction to some of the canyons in the Starved Rock area, and at the heads of the canyons some of the streams may be seen working along a joint-plane.

3. The *Platteville-Galena limestone* is unimportant topographically because of its slight thickness. Wherever it is sufficiently thick to develop

FIG. 54.—Characteristic view of sides of the canyons cut in the St. Peter sandstone of Deer Park Glen.

topographic features, canyons similar to those of the Prairie du Chien have been formed. This is illustrated by the gorge on lower Covel Creek.

4. The relief of the Morris basin in which the *Richmond limestone* outcrops, is too slight to have developed any characteristic topographic features. This limestone is rather resistant, and forms low bosses on the floor of the Illinois at its head.

5. In the *"Coal Measures"* are developed erosion features of a wide variety of types, dependent upon a wide variety of formations.

In the hard La Salle limestone, on the western flank of the anticline, numerous gorges are developed. The gorge of the lower Little Vermilion, at the northern limits of the city of La Salle, is in this limestone. Similarly, vertical rock walls form the sides of Big Vermilion Valley up to a point above Bailey's Falls. These cliffs are formed by a capping of the La Salle limestone.

East of the anticline, valleys cut in the "Coal Measures" have gentler slopes and wider bottoms. The strata are of greater age in the eastern region than in the western. They are composed chiefly of the clays and shales of the basal part of the series, and limestone is mostly lacking. These formations erode readily and do not long keep steep slopes. The valley of the Fox is largely in "Coal Measures" shales and has their typically gentle slopes. The most resistant formations of the eastern region are the

FIG. 55.—Valley side in glacial till along the Illinois east of Marseilles.

micaceous sandstones which outcrop particularly on Covel, Kickapoo, Waupecan, and Mazon creeks.

### GLACIAL MATERIAL

Valleys cut in drift are in general longer, broader, and in some cases deeper than those cut in bed rock. The glacial materials are on the whole more easily eroded than the bedded rocks, because they are in general uncemented. Till is the most resistant of the materials of the drift, and in many placs is as resistant as are the softer formations of the "Coal Measures." It has not only a stiff clay matrix whose fine particles cohere tenaciously, but is exceedingly compact, due perhaps to the pressure of the ice which deposited it. In valleys which are being cut rapidly the till forms steep slopes, sometimes 80 to 100 feet high. Some of the best types of youthful, steep, and narrow valleys of this region are in the till, especially east of Marseilles on the two Kickapoo creeks and north of Wedron on Indian Creek. The character of the slopes of Illinois Valley where they are composed of till, is shown in figure 55.

The firm, tough lake clays of the eastern region are almost as resistant to erosion as the till. The slopes along Armstrong's or Hog Run, cut in these bedded blue clays, are no less steep than are those cut in the till farther up these valleys.

Where the material is coarser, however, the cohesion of the particles is reduced, and they are washed away more readily. The most easily eroded material is the stratified drift. A stream cuts rapidly through beds of silt, sand, or fine gravel and may reach grade while neighboring streams are still flowing over rapids and falls. This is shown in Putnam County,

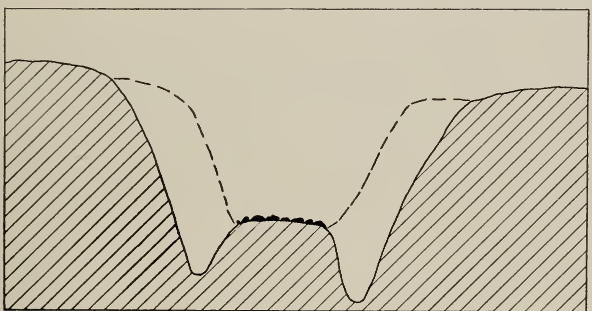

Fig. 56.—Diagrammatic cross-section of a ravine south of St. Bedes College showing the relation of the new channel in the soft drift to its old abandoned bowlder-covered valley floor.

where Allforks Creek has developed a wide, low valley with a meandering stream, while Cedar Creek and the two Vermilion rivers, streams of grater size, are still cutting canyons in rock. Allforks Creek meanders broadly in a valley as much as half a mile wide. The broad flat bed of Bureau Creek, within which the stream wanders about widely, is another example of the ease with which stratified drift is eroded. The valleys of Negro and Spring Creeks, from both of which much sand and gravel has been removed, are similarly large. Unless steepened by recent undercutting, valleys cut in sand and gravel have gentle slopes, as the loose, rounded material will not stand with steep faces.

The drift commonly contains much material too coarse for streams to transport. With the removal of the finer material, the large bowlders are left in the bed of the stream, and in time its channel may be paved with them. At the base of most slopes cut in till or gravel, large bowlders are found in profusion, and most stream beds in the drift are covered with them. These large stones are those which have resisted wear most successfully, such as igneous rocks. The paving of the bed of a stream with such bowlders checks its further wearing down. The stream then erodes more readily on the margins of its channel, at the edge of its bowlder bed. At the side of the old channel it may cut a new one in soft drift, with the result that the stream may abandon its old bowlder-covered floor. This condition is illustrated in the ravine due south of St. Bedes College, between Peru and Spring Valley (fig. 56). The original bed of the stream is covered with bowlders, and on its margins, two new channels have been cut, and the old one remains as a low ridge between them.

Fig. 57.—Resistant bed of limestone on Cedar Creek between beds of soft shale. Some distance upstream this bed of limestone forms falls in Cedar Creek.

### DEVELOPMENT OF FALLS

The development of falls is caused by the presence of a resistant bed over an easily eroded bed in the channel of an actively eroding stream. Figure 57 shows a bed of limestone over soft shales on Cedar Creek. This limestone forms rapids in the creek, and before it was worn back to its present position it formed falls in the stream. The case is similar to one in which overhanging cliffs are developed along the side of a valley. The softer underlying formation is eroded more rapidly than the harder cap rock. It is worn back therefore until the cap rock protects it from further erosion (fig. 58). Rapids are formed first (A), and these become steepened into falls (B). Later, the falls give way to rapids (C), and if erosion continues until the resistant bed is worn to the base-level of the stream (D), even the rapids disappear. If the cap rock is much more resistant than the rock beneath, the weaker formation may weather out from under the cap rock until an overhang of the latter results. This tends to hasten the erosion of the hard cap, as its overhanging edge breaks off from time to time under its own weight. In some cases erosion is aided by jointing, which breaks up the rock into blocks that are more readily attacked by the stream. The falls on Cedar Creek are being accelerated in their erosion by both of the last-mentioned conditions.

Practically every canyon in the St. Peter sandstone has falls at its head. The streams in them are young and have not yet caused their falls to recede more than a few miles from the river. Bailey's Falls on a tributary to the Big Vermilion is over the La Salle limestone and is caused by a shaly bed beneath the massive upper limestone. Smaller falls are common in the "Coal Measures" with their great variety of formations of unequal resistance; those on Cedar Creek are an example. In the cutting back of falls, a gorge, such as those about Starved Rock, is left below.

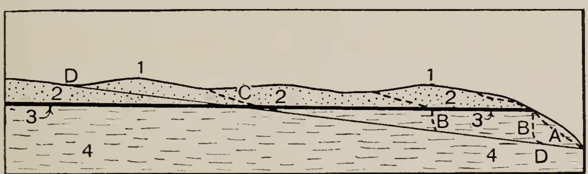


FIG. 58.—Diagrammatic illustration of the relation of falls to a hard stratum showing (1) surface outline, (2) the surface material or drift and shale, (3) the cap rock, and (4) the "Coal Measures." The dotted lines represent the stream channel at various stages, DD being base level.

If the resistant bed is at some distance below the top of the valley, the material above it is worn back more rapidly than the hard layer, and leaves the latter projecting as a rock bench or terrace on the slope. These benches are common west of La Salle, both along the sides of the Illinois and its tributaries.

### VARIATIONS IN TOPOGRAPHY OF A VALLEY

The topography of the valleys of this region is, in a general way, the result of the erosion of materials of different resistance. Different parts of the same valley may be very unlike, because they may be cut in different formations.

Illinois Valley shows striking changes in character due to this cause. Above Marseilles the valley is cut in drift where it has gentle slopes generally used for pastures. Figure 55 illustrates such a slope. Below Marseilles bed rock, chiefly sandstone of "Coal Measures" age, takes the place of the drift. Here the slopes are steeper and pastures give way to wood lots. Below Ottawa the St. Peter comes in on the valley sides, and bare, vertical cliffs are developed, which furnish the picturesque scenery of the Starved Rock region. The Prairie du Chien limestone below Utica shows similar bare bluffs, and in addition low bosses of it make the floor of the valley uneven. West of La Salle beyond the outcrop of the La Salle limestone, the slopes are again more gentle. The change of character of the floor of Illinois Valley above the mouths of the Vermilion rivers may have been influenced by the outcrop of the Prairie du Chien formation. The alluvial bottom below the Vermilion rivers gives way to an irregular, rocky floor above, practically at the western limit of the Prairie du Chien formation. This change may be due to the great resistance of this limestone to erosion, which has retarded the erosion of the entire valley above this place.

Au Sable Creek, in the northeastern part of the region, follows the western base of the Minooka ridge. The creek consists of pools of almost stagnant water, covered by swamp vegetation and alternating with stretches of fairly good flow where the creek flows on rock. This condition is due probably to the fact that the post glacial creek has cut across drift-filled depressions between rock ridges.

The valley of Mazon Creek in the shallow Morris basin, has sides which are rarely more than forty feet high. On lower Mazon Creek is a bend known as the "Ox-Bow" (fig. 34). Below "B" the valley is cut in soft sand. South of the line A-B, the material is bedded rock. The line A-B marks the southern rock slope of the glacial Illinois Valley, which the Mazon has uncovered. The development of Mazon Creek north of A is subsequent to this filling. Above A, Mazon Creek is considerably older, as shown by a filling of sand and gravel of glacial age. When the Illinois re-excavated its channel north of its glacial bed, Mazon Creek was forced to extend its course northward through the aggraded older channel. In doing this it followed the southern margin of the old valley of the Illinois for a short distance. Below the Ox-Bow, the stream winds along with sluggish current and broad meanders; above, the valley is cut in "Coal Measures" and generally shows steep sides.

Saratoga, Nettle, and Waupecan creeks and Bill's Run have shallow valleys, which were partly filled during the deposition of the late Wisconsin valley train in Illinois Valley. The headwaters of Nettle Creek are collected from the broad eastern flank of the Marseilles moraine. The run-off from the moraine follows several series of glacial depressions, and the streams thus formed converge eastward to form Nettle Creek; most of the headwaters of the streams which drain this moraine possess such glacial depressions, without having done any appreciable work in their enlargement.

Walbridge's and Covel creeks similarly have ill-defined shallow upper valleys; but their lower valleys are deep, stream-cut channels which are extending headward and cutting a bed in the shallow depression above. Covel Creek illustrates well the unequal resistances of materials. Its lower course is cut in Platteville limestone and has cliff sides; above, in the "Coal Measures," the slopes are gentle.

Fox River is marginal to the western base of the Marseilles moraine. The slopes of the valley are on the whole gentle and wooded, or pastured; the materials which compose them are till or "Coal Measures" clays. At Wedron, however, the St. Peter sandstone rises high above the valley, and here its sides become sheer cliffs.

In the tributaries west of Ottawa, the canyon type of the St. Peter prevails. Figure 59 shows typical profiles from the valley of Clark's Run.

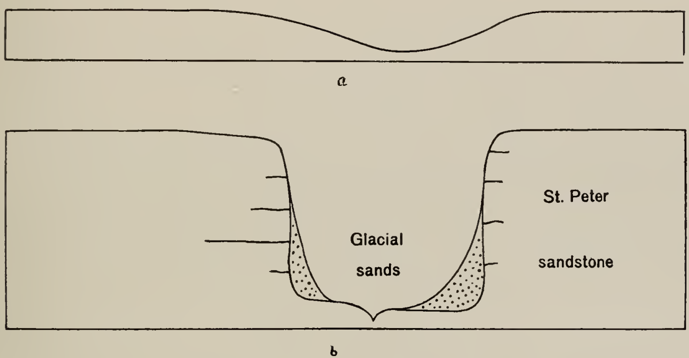


FIG. 59.—Diagrammatic cross-sections of different parts of the valley of Clark's Run: *a,* valley cut in soft "Coal Measures" and till; *b,* valley cut in St. Peter sandstone.

The valley above the falls is cut in "Coal Measures" and till, and is broad and flat. The falls mark the upper limit of cutting in the St. Peter.

At the crossing of the Utica-La Salle road on Pecumsaugan Creek falls have been formed in the Prairie du Chien formation. Below, the stream flows in a rock gorge; above, its valley is a marsh, grown up with reeds, within which the creek flows feebly. The valley of Pecumsaugan Creek is another example of a morainic depression in its upper course, and of a stream-cut valley below.

Little Vermilion Valley crosses the La Salle limestone in its lower course, and has developed here a narrow gorge, extending upstream from the bluffs of the Illinois to the point where the Illinois Central Railroad leaves the valley. Above the outcrop of the La Salle limestone, the stream lies in soft shales, and has formed a broad, flat valley. Above the mouth of Tomahawk Creek, where the stream crosses the St. Peter and Prairie du Chien formations, the valley again is narrowed, and its slopes are vertical bluffs.

## Man as a Factor in Erosion

### RECENT CHANGES

The processes of erosion work slowly, as man counts time, and for this reason he has paid but little attention to the possibilities of their control, or to the fact that his activities influence these processes in many ways. Savage man did little to destroy the soil cover, or to invite the gullying of the surface in other ways. In his time, the upland was covered by the thick sod which the prairie grass formed, and on the slopes of the valleys grew trees and brush which protected the soil from wash; man was an unimportant factor in erosion. Early travelers have left accounts of this country before the coming of the white man, of thick prairie grass which

Fig. 60.—Destruction of soil on a slope as the result of denudation of Fox Valley.

stretched, an unbroken sea of waving blades, over the upland, interrupted here and there by tongues of woodland along the streams, and of streams that flowed clear and pure. Today the scene is much altered. The grassy prairies have been converted into tilled fields, and the soil is bared to the action of wind and water. Much of the timber has been removed from the valleys; gullies are cutting back into the prairies in many places, and the streams run murky with their load of sediment washed in from plowed fields and denuded slopes. The ways in which man has stimulated erosion are principally:

### EROSION INCREASED BY DEFORESTATION

Timber is confined to the valleys and, because of its scarcity, has been at a premium since the settlement of the region. The original small supply was rapidly reduced by the increasing demand. In the cutting out of the usable timber, the protecting cover of the soil was destroyed, and the steep slopes of the valleys were exposed to slope wash. In some places these cut-over slopes have become covered with grass or brush, but in many places they have been gashed by gullies. Such a denuded slope, which is being ruined rapidly by erosion, is shown in figure 60. These gullies, once started, work back and may become destructive to the fields on the prairie beyond the valley.

### EROSION INCREASED BY OVER-GRAZING

Because of the agricultural value of the prairie land, the farmer has in many cases used all of his prairie land for cultivation, and has pastured his


FIG. 61.—Gravel fan (*A*) spread over field on Cedar Creek.

cattle on the less valuable slopes of some valley. Wood lots and cut-over slopes are often used for cattle pastures. The hoofs of cattle have cut the sod, and over-grazing has killed the grass in places, so that the soil has been laid bare, to be washed by rains and blown by winds. Damage has been done especially in using slopes that were too steep or by pasturing too many cattle upon hillsides. These conditions are perhaps worst in Fox Valley, and especially along its eastern side, where gullying has impaired seriously the value of slopes which have been carelessly used for pastures, and which might have been kept in a productive state by more restricted grazing, or by letting them remain in timber.

### EROSION INCREASED BY CULTIVATION OF SLOPES

Where land is valuable, the temptation is great to extend the cultivated area to its maximum. Slopes have been tilled which are too steep, and whose soil is too readily washed to make such cultivation advisable. Particularly if the ground is plowed improperly, if the surface is left to cake and become compact, or if the humus is exhausted, soil which responded properly at first to cultivation, may wash and become uncontrollable. In Bureau County, many hillsides of fertile loess have been farmed recklessly, and in a number of cases have been gullied until they are nearly worthless.

### RESULTS OF SOIL EROSION

Whatever the cause of erosion, the results affect much more than the denuded slope. Gullies work headward beyond the hillside on which they started, and attack the level upland behind. The material which has been eroded may be dumped at the base of the slope, and damage the fields in the valley below. Fields on valley bottoms may be overspread by wash from the higher slopes, and be injured for agriculture. Figure 61 shows gravel which has been washed down over a field, and has made it worthless. The gully from which the gravel has come was caused by allowing a lane on the hillside to wash until the lane became a gully. Other results are the fouling of streams with sediment, the consequent depreciation of their value for navigation, water power, and water supply. The deforestation of slopes, too, has increased the danger of floods, since waters flow more rapidly over treeless slopes than through forests.

### SOILS MOST AFFECTED

A soil which is highly resistant to erosion is a soil which has sufficient porosity to absorb a large proportion of the water that falls upon it, and yet a sufficient cohesion of its particles to oppose the wear of the water that runs over it. Such a soil is a moderately sandy loam, somewhat more porous than the average soil of the region.

The very porous soils derived from the local stratified drift are too loose to withstand erosion successfully. The ''high-level'' gravels are commonly considerably eroded. The sands of the Hennepin flat are deeply trenched by gullies. Beds of silt are almost as easily eroded. Figure 62 shows a young gully developed on the crest of a ridge between the larger gullies a and b. A wagon trail formerly led along the ridge between the two larger ravines. As the sod was destroyed, the loose silt which underlies the ridge was readily eroded.

The clay soils derived from the till withstand erosion much better, but because of their compactness do not readily absorb the water which falls upon them, and as a large proportion of the rainfall runs off over the surface, they are somewhat subject to erosion.

## PROPER USE OF STEEP SLOPES

The problem of the best use of the lands is new to the American farmer, accustomed to think of the resources of this country as inexhaustible. The rapid taking up of our remaining uncultivated agriculture lands, and the increasing demand for farm products by our growing industrial population, are gradually enforcing a more careful use of the land. The farmer has learned to maintain soil fertility by crop rotation and by the use of fertilizers. He is now learning to use all his land to the best advantage. Wherever he is cultivating slopes, he must learn to protect them from erosion by contour plowing, by keeping the land covered with some kind of growth as much of the time as possible, by keeping the soil mellow with


Fig. 62.—Gully formed in silt east of Marseilles. This gully was originally a wagon road following the crest of a small ridge between the valleys a and b. The wagon wheels destroyed the sod and started erosion.

abundant humus and frequent cultivation, and by checking the growth of gullies by filling them with straw or brush or by planting in them fast-growing brush. On steeper slopes, pastures are profitable in many cases, especially where a spring furnishes a good supply of water. In places, the best use of a slope consists in keeping it well timbered, or if the timber has been cut, in reforesting it. Only so can slope wash be kept in check on some slopes, and the adjacent upland fields be protected. The scant local supply of timber and the ready growth of trees advises this course at times, not only as a protective measure, but as a source of profit.

# CHAPTER VII—SETTLEMENT AND DEVELOPMENT OF UPPER ILLINOIS VALLEY

## Geographic Influences

The physical processes that determined the geologic structure and the geography of this region also affect man at every turn and are bound up in many ways with his welfare. They are recognized most readily and are of most immediate importance in the geographic environment which they have created for him. All the fabric of the history of the region is woven about the warp of its physical conditions, which define in a large sense both the past and present of the region and the possibilities of its future. Infinite in their complexity, the most important of them are: (1) character of the surface and its drainage lines, (2) location of the region in the heart of the Prairie States between the Great Lakes and Mississippi River, (3) relation of prairie to woodland, (4) character of the soil, (5) mineral resources, and (6) water power. All these factors have a larger and a more restricted application—in the larger sense, as relating this region to other regions; in the narrower sense, as differentiating its various parts. Physical conditions outside this area also have had far-reaching influences at various times on local matters.

## Indian Life

Although the Indian did almost nothing to develop this region, and except for a few years in the early thirties, was not even an obstacle to its settlement, he is worthy of attention because of the interest that attaches to him in local legends and in pioneer history. Because he was a savage, the Indian depended more directly upon his natural environment than the white man who followed.

The first owners of the valley, so far as known, were of the Illinois tribe of Indians, who for a time held undisputed sway over all the territory drained by the river which bears their name. They were prairie Indians and lived largely by the chase. They are said to have been less susceptible to culture than the Indians of the wooded areas and to have known less of agriculture.[1] The vast pastures of prairie grass and the wooded areas along the valleys harbored abundant animal life, on which they drew for food. The abundance of game caused the Indians to live by hunting and kept them unskilled in agriculture. Their dependence on game forced them to wander widely on hunting trips. Consequently they did not build

[1]Caton, J. D., Last of the Illinois, pp. 12 and 13, 1876.

permanent homes, and social institutions remained very primitive. Moreover, the tough prairie sod did not invite cultivation. The Indians built some "towns" where they gathered in the fall at harvest time and left the weaker members of their tribe more or less permanently. Apparently these towns were mere clusters of wigwams, with a few poorly cultivated patches of maize, beans, and pumpkins about them. A town on the site of Utica is generally mentioned as a tribal rendevous of importance. Early French writers speak of it as swarming with thousands of Indians in the late fall, although almost abandoned during the rest of the year. A similar, but smaller "town", stood on the site of Channahon. The reason for the location of these places is unrecorded, but both sites are surrounded by soils well suited to such methods of cultivation as the Indians knew. In contrast to the heavy clay soil of the prairies, and even to most of the alluvial soils of the valleys, the soil in these places is sandy and light. It yielded readily to the weak tools and intermittent industry of the Indian and grew fair crops with little cultivation. The settlement on the site of Utica was protected by the French military post across the river at Starved Rock, where at times the Illinois Indians took refuge from marauding tribes. The Channahon settlement was located at the confluence of three streams which afforded a measure of protection and served as highways.

The annals of the Indian tribes which inhabited successively Illinois Valley are a melancholy record of warfare and depredation. For years the Illinois were subject to raids at the hands of the Iroquois tribes of New York. When strongest the Illinois tribe retaliated by similar expeditions, some of which carried them into Mohawk Valley. In 1680 the Iroquois came down in force and drove the native Indians from their land, but two years later the Illinois tribe re-established itself in Illinois Valley. Much later the Iroquois drove out the Pottawatomies, Sacs, and Foxes, from their grounds in southern Michigan and adjacent states.[2] These displaced tribes emigrated into Illinois where they naturally came into conflict with the resident Illinois Indians, and through long-continued war gradually wore out the once-splendid tribe.

The last line of defense of the Illinois Indians was upper Illinois Valley. The surrounding prairies afforded no adequate refuge, and for years they retreated in time of danger to sheltered places along the bluffs of the upper Illinois. They are said to have entrenched themselves at Joliet, along the Kankakee, at Marseilles, where the rapids made the landing of a hostile force difficult, and last of all at Starved Rock, impregnable by its isolation, and conquered only by a greater foe than man. The fate of the Illinois is written in the character of the surface of their land. Their territory was open to attack; on all sides their hunting grounds were in

[2]Baldwin, E., History of La Salle County, pp. 64-66, 1877; also Caton, J. D., The Last of the Illinois.

dispute with neighboring tribes; eastward the land lay open for almost a thousand miles, and down this open stretch swooped various marauding tribes. The strength of the Illinois was broken permanently in the memorable massacre at Starved Rock. Those who were left drifted south into oblivion. After the feeble hold of the Illinois on the upper valley had been broken, came Pottawatomie, Sac, Fox, Winnebago, and Kickapoo, fugitives before the westward-pressing white men, sojourners for a day, who never established themselves in this region nor left their stamp upon it.

## French Explorations

While the Illinois tribe was still in its prime, the first white men came to the valley.[3] They were Frenchmen, soldiers eager to add new lands to the French domain, also missionary priests, and trappers and traders known as *voyageurs* and *coureurs du bois* (''wood runners''). These three classes of men represent the great ends for which the French pressed westward into this unknown domain. (1) Stories of natural wonders, strange peoples, and marvelous riches fired the imagination of Europeans during the sixteenth and seventeenth centuries. The desire to explore new lands possessed adventurous minds the world over. This motive was strong in all the early expeditions which penetrated the Mississippi Basin from the time the first Spanish adventurers wandered about the lower Mississippi Valley. One of the great incentives for adventurous exploits lay in the search for a western passage to the Pacific Ocean, a search which continued for almost a century before hope of its success was abandoned. (2) Glittering schemes for the colonization of the interior, agricultural and others, led provincial governors, from time to time, to despatch expeditions inland from the northeastern provinces. (3) Almost always abreast of the soldier, and sometimes ahead of him, came the zealous missionary, friar of one of the numerous holy orders that proselyted in the rich field of heathendom here opened to them. (4) The strongest motive of the French in penetrating the interior was the profit to be made from the fur trade. The garrison here, as everywhere in the French provinces, also was a trading post, and soldier, priest, and trader alike turned a penny in bartering utensils, arms, trinkets, and often firewater, for pelts.

The expansion of the French into the interior was very rapid. In 1608 the first settlements were established about Quebec; in 1673 the canoes of Frenchmen were already on Mississippi River more than a thousand miles inland. While most of the English colonists still were confined to the narrow coastal region of the Atlantic colonies, Frenchmen were building stockades on the Mississippi and its tributaries. The phenomenal expansion of a handful of men over an area a thousand miles wide in sixty-

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[3]For a general discussion presented in masterly fashion, see F. Parkman: LaSalle and the discovery of the Great West.

five years is due to several reasons: (1) The French entered the continent by way of the St. Lawrence and the Great Lakes. These waterways afforded a relatively easy route into the heart of the continent. From the Great Lakes the French passed by means of short portages to tributaries of the Mississippi, whose watersheds are crowded close to the lakes. (2) The French secured a footing in the northern half of the continent, which was richest in valuable fur-bearing animals. In the fur trade a few men could work a large area, and a small European population was in some ways an advantage rather than a handicap, while the Indian hunter remained an invaluable asset to the prosperity of the business. (3) The poverty of the soil in much of eastern Canada discouraged agriculture and dense settlement, and many of the settlers either turned to fur trading or sought farms farther west.

Upon these general conditions are based the operations of the French in upper Illinois Valley. The first Frenchmen known certainly to have entered this region are Marquette and Joliet, who on their return from the exploration of the Mississippi in 1673, chose to breast the gentle current of the Illinois rather than the swift Wisconsin River. Six years later Robert Cavelier, Sieur de la Salle, crossed from Lake Michigan to Illinois River for the purpose of founding a colony. "It was the knowledge of these things joined to the poverty of Canada, its dense forests, its barren soil, its harsh climate, and the snow that covers the ground for half the year, that led the Sieur de la Salle to undertake the planting of colonies in these beautiful countries of the West."[4] His first attempt resulted in the building of Fort Creve Coeur on Lake Peoria. In 1682 he led another expedition southward, completed the exploration of the Mississippi to its mouth, and took possession of the interior for the king of France, naming it Louisiana.

In his trips along Illinois Valley, La Salle came to recognize the advantages of Starved Rock, especially its capacity for defense and its control of one of the largest Indian villages in the north. Accordingly toward the close of 1682, he despatched his lieutenant, Tonty, with a troop of men to Starved Rock to build a fort. La Salle soon joined them at the task, which they completed in March, 1683. He named the fort *St. Louis des Illinois.*

Starved Rock, known to the French as Le Rocher, presents an admirable site for a fortification. At its northern base flows Illinois River, above which the sheer rock walls rise 130 feet. Its landward side is almost inaccessible except at one place, which affords a convenient, yet easily defended approach to the natural fortress. A level area of less than an acre provided room on top for the French to build a small stockade. As long as food lasted, the fort was impregnable. It controlled Illinois River and was accessible by this water route from the other French posts.

[4]Memorial of La Salle to the minister Colbert; quoted from Francis Parkman, La Salle and the discovery of the Great West, p. 111, 1869.

La Salle had planned to establish here a great French colony and to develop the country round about. In 1687 Joutel writes enthusiastically of the beauty and fertility of the country and of its mineral wealth.[5] In his journal, he gives what is probably the first account of the mineral resources of the region, in a statement concerning its limestone, its fire clay, and particularly its coal. He says, "On the sides of the hills is found a gravelly sort of stone, very fit to make lime for building. There are also many clay pits, fit for making earthenware, bricks and tiles and along the river are coal pits, the coal whereof has been try'd and found very good." To the eyes of the Frenchman, accustomed to the scant vegetation and harsh climate of northeastern Canada, this region presented the attractiveness of Arcadian plenty in its fertile soils, its moderate climate, its luxuriant vegetation, and its abundant game. The agricultural colony planned was never established, however. For a time the post throve by its trade with the Indians, who flocked to the settlement across the river for the protection the guns of the French afforded. In 1687, however, La Salle met his fate on another colonizing venture, and Tonty abandoned the fort a few years later. It was occupied occasionally thereafter by French traders; but the Indians left unprotected dispersed gradually, and the fort fell into ruins. With the passing of Fort St. Louis ended one of the most wisely planned of French colonial enterprises, and one which promised excellent results. It is impossible to say for how much the energy and abilities of La Salle would have counted in the success of the venture, had he lived. Not long after, however, the entire scheme of French colonization in America collapsed. It was from the start an unstable structure, based on the strength of a handful of soldiers and traders, for the most part, without the firm foundation of agricultural colonization. The French regime left scarcely a trace in Illinois Valley. The region lapsed into savagery, and its resources remained undeveloped and almost unknown to white men for a century and a half.

### Westward Movement of Population

While[6] the French were building Fort St. Louis on the Illinois, the English colonists were engaged in settling the Piedmont slopes at the seaward base of the Appalachian Mountains, their frontier settlements only a few score miles from tide-water. When, eighty years later, the French gave up their holdings on the North American continent, the English colonists had not yet passed the Appalachian barrier, except at the south where a thin stream of settlement had penetrated the mountain passes and spread into the upper valleys of streams that go down to the Mississippi. For the

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[5]Journal of the last voyage, London (1714), pp. 171-172.

[6]Pooley, Settlement of Illinois; and Barrows, H. H., Illinois Geol. Survey Bull. 15, give a good general account of this westward movement. In addition La Salle County possesses a local history of unusual merit in Baldwin's volume cited below.

English-American colonist no chain of lakes and rivers pointed an easy way inland, and the ridges of the Appalachians barred the way westward until the Atlantic colonies could no longer support their accumulated population. From this firm agricultural base, however, expansion once begun was irresistible.

### Pioneers from South

Most of the pioneers who blazed the western trails were from the southern seaboard states, and the first wave of settlers that overspread the Mississippi basin, except its extreme northern part, was from the South. The northeastern states were engaged largely in commerce and navigation and developed manufacturing interests at an early date. In these various pursuits that part of their population which could not engage in agriculture found the means of a sufficient livelihood. The South on the other hand, enjoyed no such variety of occupation but devoted itself almost exclusively to agriculture. Hence it was unable to support as dense a population as the North and became overpopulated much earlier. The injury to the soil in many places by the exclusive cultivation of tobacco and the discouraging effect of slave labor upon free labor also stimulated emigration from the South to the new western lands. Likewise at the close of the eighteenth century the obstacles to expansion in the South were not so great as in the North. The North had only one highway to the west, the Hudson-Mohawk depression. This way, however, remained closed until near the end of the eighteenth century because the Iroquois Indians held its western part.

A series of gaps opened up passable, though devious, routes westward from southern Pennsylvania, Virginia, and the Carolinas,and through these poured the emigrants. By 1790 a considerable number of emigrants from the southern states had formed settlements in the Blue Grass region of Kentucky, in the Nashville area, and in Western Pennsylvania.[7] Several routes from the Atlantic seaboard focused upon Pittsburgh on Ohio River and were used increasingly as means of river transportation on the Ohio were developed and as the danger from Indians in Ohio Valley grew less. By keel-boat, barge, and raft the pioneers floated down the Ohio in large numbers, at first to settle south of the river, but gradually also to spread northward into Northwest Territory, under which name all the lands north of the Ohio River were at one time organized. In 1802 Ohio was admitted to statehood, with a zone of settlement confined almost entirely to the Ohio basin. By 1810 the lower Wabash Valley had been occupied, and settlements sprang up along the Ohio to its mouth, joining the old French settlements in the American Bottoms near St. Louis to the settled area on the Ohio and in Kentucky.

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[7]The best graphic representation of the westward movement of population discussed here and on subsequent pages is given by the maps of the Statistical Atlas of the Census of the United States. These show the areal distribution of population for each ten-year period from 1790 to date. Parts of some of these maps are reproduced by Semple, American history and its geographic conditions; and by Barrows, H. H., Illinois Geol. Survey Bull. 15, Geography of the middle Illinois Valley.

The wave of emigrants first overspread southern Illinois and then moved northward up the valleys of the Mississippi and its tributary streams. By 1818 it had reached the mouth of Illinois River and brought settlers enough to the territory to secure statehood for Illinois. The movement from the South continued actively to about 1830, aided greatly by the development of steamboat navigation.[8] By that time Illinois Valley was fairly well settled as far north as the Sangamon country, and a few settlers had found their way even into the upper Illinois Valley.[9] The first cabin in Bureau County was built in 1828 "by a spring near a small branch," a typical site for the southern settler.[10] These settlers were woodsmen who knew not the prairie but sought out the belts of timber along the valleys. In 1829 a Pennsylvanian built his home in Putnam County,[11] and in the early thirties a dozen families were reported within the limits of the county.[12] In La Salle County a number of settlers were established in the late twenties, several families on the bluff south of Ottawa, one settler at Bailey's Grove (1825), and one each in Dayton and Rutland townships (1829). In 1830 more came, and in that year the first election in the upper valley was held at Green's (now Dayton, La Salle County) in the Fox River precinct of what was then Peoria County. At the beginning of the Black Hawk War fifty persons were reported on the lower Fox and about Ottawa, four or five families on Indian Creek, an equal number about La Salle and at Bailey's Grove, and about three in Vermilion and in Deer Park Townships.[13] There were only two families in Grundy

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[8]An interesting picture of the transportation conditions of the time is given by A. D. Jones in "Illinois and the West." (Boston 1838: pp. 30-36.) (1) *Steamboats:* "St. Louis is the great starting point of the West. Hither from every quarter of the East and South, travelers and immigrants flock in uncounted numbers. Every hour of every day they are disembogued (sic) upon the beautiful levees of this city in scores on scores, seeking pleasure and a home in this wondrous world just opening to them. From hence, every hour of every day witnesseth their departure, into the interior of Missouri, up the Mississippi, Missouri or Illinois rivers. * * * * An eastern man can have no idea of the tide of travel on these mighty waters."

(2) *Wagons:* Hosts of farmers with made their way across the country in caravans of prairie schooners, and accompanied by their live stock. (3) *Raft and flat-boat:* These sail down the current to the mouth of the Ohio and there they are broken up, put on board steamboats and taken to St. Louis, from where their contents are distributed over all the country, and the people thereof seek their destination."

[9]Ford, H. A., History of Illinois, pp. 102-103: "The population of the State had increased by the year 1830 to 157,447; it had spread north from Alton as far as Peoria, principally on the rivers and creeks; and in such places there were settlers sparsely scattered along the margin of the Mississippi River to Galena, sometimes at the distance of a hundred miles apart; also on the Illinois to Chicago, with long intervals of wilderness; and a few sparse settlements were scattered about all over the southern part of the military tract. The country on the Sangamon River and its tributaries had been settled, and also the interior of the south; leaving a large wilderness tract yet to be peopled between Galena and Chicago; the whole extent of the Rock River and the Fox River countries, and nearly all the lands in the counties, * * * * comprising (the remaining) one-third of the territory of the State. As yet but few settlements had been made anywhere in the open wide prairies, but were confined to the margins of the timber in the vicinity of rivers and streams."

[10]Matson, Nehemiah, History of Bureau County, p. 87, 1867. In "Tax-payers and voters of Bureau County" the following population growth for the county is recorded: 1828, 5 families; 1830, 9 families; 1831, 16 families; first election, 19 votes cast (p. 90); 1832, 31; 1833, 28 (due to the Black Hawk uprising).

[11]Ford, H. A., History of Putnam County, p, 85, 1860.

[12]Ellsworth, S., The olden time (in Putnam and Marshall counties), p. 159.

[13]Baldwin, E., History of La Salle County, p. 88, 1877.

County at this time (1832),[14] and only a few in Will County, principally about Channahon. In 1832 the Sacs took to the warpath, and many settlers left. When peace was restored, southern emigration was deflected to the southwest by the flood of northern emigrants which spread over this region. Although the southern woodsman was the pioneer in this region, his influence soon was overwhelmed by the host of northern emigrants.

### Control of Region by Northern Settlers

In the early part of the nineteenth century the attention of the Northeast began to turn to the possibilities of the interior states. Overpopulation made itself felt gradually in the industrial and commercial districts of the North; the War of 1812 had crippled our commerce considerably; a series of poor years in New England caused the farmers of that region to lend willing ears to the tales of the rich western country. Moreover, the Indian tribes had been removed from Mohawk Valley, and the way to the West lay open. By 1810 western New York was settled, although not densely peopled. By 1820 a fringe of population encircled Lake Erie. In 1825 the Erie Canal was completed, providing, together with the Hudson River and Great Lakes, a cheap water route from the Atlantic to the Middle West. Upon this northern route was exerted also the greatest pressure of population from the densely settled states of the Northeast. It is not surprising therefore that the Erie Canal drained off the surplus population with unprecedented rapidity. Settlements spread south rapidly from Lake Erie to join the older Southern settlements of Ohio and Indiana. For a brief period the peninsula of Michigan held settlers back from the Illinois territory. Only a few had the hardihood to carry their goods across from Maumee Bay or Detroit into northern Illinois. By 1832, however, steamboats were carrying passengers to the ports of Lake Michigan; and in that year emigration by lake to Illinois began in full force.[15]

A few Southern settlers still came into upper Illinois Valley in the thirties. After 1831 they were brought by steamers that plied the Illinois as far as Ottawa. There was but a handful of these Southerners, however, and they were lost in the mass of Northern emigrants who came at this time and almost from the start dominated the region and fixed upon it the stamp of northern institutions in church and social life as well as in government. The proportion of Northern to Southern emigrants is shown by the roll of old settlers of La Salle County, compiled in 1877.[16] There were in the county at that time 80 settlers from New York and New Jersey, 58 from New England, 59 from Ohio, 31 from Pennsylvania, and 21 from the South.

[14]Armstrong, Perry, Address Old Settlers' Association, July 4, 1876, Morris.

[15]La Salle County directory, 1858, Ottawa, Introduction.

[16]Baldwin, E., History of La Salle County, 1877.

The seven eastern townships of Bureau County had 655 settlers from the Northern states and only 54 from the South.[17]

For several years preceding 1832 upper Illinois Valley received occasional settlers from the East. These came most of the way by wagon from Toledo or Detroit, or from the settlements of central and southern Ohio. It was thus that some of the first settlers came to Ottawa and to Dayton Township in 1829;[18] that a group of colonists from Ohio, Pennsylvania, and New England reached Putnam County in 1829 to 1830, forming the Union Grove settlement;[19] and that the Hampshire colony from Northampton, Massachusetts, came to Princeton in 1831.[20]

The development of steamboating on the Great Lakes, more than any other factor, facilitated the settlement of northern Illinois. The difficulties of transportation which previously had kept many emigrants from pushing westward to Illinois were removed as steamboats established routes to Chicago. For several years after steamboats appeared on Lake Michigan, however, they could not accommodate the crowds of emigrants, and even in the late thirties the overland route still was used.[21] In 1833 the lake steamers carried more than 43,000 emigrants west from Buffalo[22] and in 1839 a regular line of steamboats was established. In the summer of 1835, 1,200 persons are said to have left Buffalo daily for the West,[23] and in 1839 a regular line of steamboats was established which plied between Buffalo and Chicago. The cost of transportation was cut from year to year, and by 1840 the fare from Buffalo to Chicago had fallen to $20. This rate was reduced to $10 in 1850. In 1852 the trip was made in from four to six days at a cost of $4 to $8.[24]

One of the first regions west of Lake Michigan to be settled by Northern emigrants was Illinois Valley. The sandy plains about Chicago repelled the settler. Outside the valleys of the Illinois and its tributaries, most of northeastern Illinois was prairie, at first shunned by the settlers. The first settlements by Northern emigrants were in the timbered belts along the valleys, in sites corresponding to those of the Southern woods-

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[17]Summarized from a list of tax-payers of Bureau County in "Voters and tax-payers of Bureau County."

[18]Keyes, Directory of La Salle County; and Baldwin, E., History of La Salle County, relate that in 1829, several settlers came from Licking County, Ohio, with four yokes of ox teams hitched to their wagons. They were 45 days on the road, often making less than ten miles per day.

[19]Ford, H. A., History of Putnam County, p. 90, 1860.

[20]Matson, Nehemiah, Reminiscences of Bureau County, p. 261.

[21]Baldwin, E., History of La Salle County, p. 121, 1877. Baldwin left Connecticut in 1835, went by steamboat to Albany, thence by rail to Schenectady, and from Schenectady by canal-boat to Buffalo. A steamer took him from Buffalo to Detroit, and from there he followed the territorial road to the mouth of the St. Joseph River. A lumber schooner afforded transportation to Chicago. The stage line to Ottawa was engaged for so many days ahead that he left Chicago on foot for La Salle County.

[22]Pooley, W. V., Settlement of Illinois from 1830 to 1850, p. 359, 1908.

[23]Idem, p. 360.

[24]Curtiss, D. S., Western portraiture, p. 303, 1852.

men before them. In Putnam County, Ox Bow Prairie and Union Grove were settled in 1831, and a settlement was made at Granville in 1834. The settlement of Bureau County had been retarded by Indian raids during the Black Hawk War, and its population did not grow much until after 1834. In 1836 alone, however, the population of the county more than doubled, for during the preceding summer the Indian land of the northern part of the county had been thrown open to settlement. The first northern settler in La Salle County located near Ottawa. In 1835 the Rockwell colony was established near La Salle by settlers from Norwich, Connecticut, but was soon broken up by sickness. As in Bureau County, the year 1836 brought the largest number of emigrants to La Salle County;[25] at this time the towns of Dayton, Ottawa and Marseilles were laid out. Grundy County, consisting mostly of prairie, was settled later, the earliest settlers locating probably on the site of Morris, in 1834.[26] Channahon in Will County, was settled in 1833, and received a large addition from New York in 1834.

From the headwaters of the Illinois the wave of northern emigration spread south and west and mingled with the earlier Southern settlers who had pushed up lower Illinois Valley and its tributaries. By 1840, settlements extended from Chicago to the mouth of the Illinois. By 1850, settlements had spread out over all the smaller prairies.

## Conditions of Pioneer Life

### PROBLEM OF THE PRAIRIES

The newly arrived emigrant found himself in a region to which his old home offered few parallels. In spite of the voluminous advice of guide books for emigrants, he was a stranger in a strange land. One of the great problems which confronted the settler from the wooded hills of New England was the almost level and nearly treeless prairie, which covered much of the State.

The prairies of Illinois are essentially the uneroded, drift-covered upland, and the wooded lands are chiefly narrow belts, marginal to the valleys of the streams. At the time of settlement, the woods and the prairies were distributed as follows:[27] (1) Southern Illinois was chiefly woodland, with small detached prairies in the interstream areas. (2) South and west of a line from Rock Island to Peoria, and thence to Champaign, mixed woodland and prairie prevailed, the proportion of prairie to woodland increasing away from Mississippi Valley. (3) North and east of this line the land was mostly prairie. East-central and northern Illinois were covered

[25]Kett, Past and present of La Salle County, p. 194.

[26]Armstrong, Address at Old Settlers' Reunion, Morris, 1876.

[27]See map in Gerhard, Illinois as it is, p. 216, reproduced also as figure 35 in Bulletin 15, Ill. Geol. Survey.

by a younger till sheet than the country to the west and south, and hence the northeastern part of the State is less dissected by streams and also has less timber. The belt of woodland along Illinois Valley divides this region into two parts, the eastern of which was known as the Grand Prairie. (4) The extreme northwestern part of the State, which remained unglaciated, was a wooded area.

The counties of upper Illinois Valley belong to the third of the divisions mentioned, in which the valleys of the Illinois and its tributaries formed the largest timbered area. The pioneer in this region had the choice of homesteading in the timber, or at its margin, or out on the open prairie. During the first years, homesteads were taken up in the timber or along its edge; the open prairie was avoided, and many thought it must always remain waste land. In 1821 a man sent to explore upper Illinois Valley for a colonization site reported that he had found there no site suited for such a purpose.[28] Even in 1834 a traveler wrote of the desolation of these plains.[29] Some of the objections to the prairie were based on superstitions that were soon dispelled, others were due actually to adverse conditions. Some of them were: (1) One of the early superstitions held that the prairie was a desert, unable to support any vegetation other than native grasses. The absence of timber was considered an evidence of the poverty of the land. This idea was expressed by Monroe in a letter to Jefferson:[30] "A great part of the territory is miserably poor, especially that near Lake Michigan and Erie, and that upon the Mississippi and Illinois consists of extensive plains which have not had from appearances, and will not have, a single bush upon them for ages. The districts therefore within which these fall will perhaps never contain a sufficient number of inhabitants to entitle them to membership in the Confederacy." This notion soon was disproved, as the settlers became acquainted with the rich black soil and the luxuriance of the grassy growth upon it. (2) Another prejudice, less readily discredited, pictures the winter climate of the prairies as too severe for human habitation. Wonderful tales of the bitter western winters circulated through the country for years. In Hoffman's "A winter in the West," are painted doleful pictures of the winter climate, and emphasis is placed on the prodigious effect of the freezing winds from the Rocky Mountains which "Do sorely ruffle; for many a mile about, there's scarce a bush." "The general impression was that only the timber belts would ever be inhabited. The prairie, swept by the fires of summer and the piercing blasts of winter, seemed little better than a desert, and for several years there was not a cabin in Grundy County, built more than 100 yards

[28] Baldwin, E., History of La Salle County, Narrative of Hodgson's exploration, pp. 76-78, 1877.

[29] Hoffman, C. F., A winter in the West, Letter 18.

[30] Writings, vol. 1, p. 117.

from the timber.''[31] The belief that the prairie was treeless because of the severity of the winter remained prevalent for some time. (3) The tall grasses of the prairie were highly inflammable when dry, and the danger from fires was great to the first prairie homesteads. A prairie fire, once started, might sweep over miles of the nearly flat surface faster than man could ride. In numerous instances houses and crops were destroyed by such fires. (4) The matted roots of the prairie grasses formed a tough, heavy sod which the pioneer found it difficult to break with the weak tools and the few draft animals in his possession. Heavier plows were made presently, and in a few years a plow was developed with a mould board shaped especially to turn the heavy sod. In a few years also, the farmer's stock had increased so that he no longer was handicapped by a lack of working animals. (5) The apparent lack of water on the prairie deterred settlers. Only after some time did they discover that water was accessible by shallow wells almost everywhere on the prairie. (6) In areas remote from wooded valleys, the lack of wood formed an insuperable barrier to settlement. Timber for buildings, fences, fuel, tools, and other purposes, was an absolute necessity. (7) The large prairies were unavailable for settlement so long as the only means of transportation was by wagon or horseback. The cost of hauling farm products to market and of getting necessities not produced on the farm limited the pioneer settlements to sections which could ship by some waterway.

For these and other reasons, the settlement of the prairie was difficult. In the timbered belt, on the other hand, conditions were favorable for homesteading. Cultivatable land was to be had in the creek bottoms, and at the edge of the prairies, where the sod was less heavy than farther from the timber. The hillsides furnished many springs of good water. Near them the frontiersman generally built his cabin and his barn. The valley slopes also sheltered buildings from prairie fires and winter winds. Above all, here was timber in abundance, and here, in most cases, the pioneer had easy access to water routes.

The pioneer was thus limited by the conditions of his environment to the timbered areas. The first homes were built in or along the edge of the best timber.[32] Even how, descendants of some of the first settlers speak of ''the old homestead down in the timber,'' which has been abandoned in most cases for a modern home well out on the prairie. A number of large timbered valleys favored the early settlement of La Salle County, and their absence retarded settlement in Grundy County. In La Salle County the first settlers located in the valleys of the Illinois, the Big Vermilion, and the Fox. A dozen families which settled along the timber of Nettle and

[31]Baskin, History of Grundy County, p. 148.

[32]Baldwin, E., History of La Salle County, p. 87, 1877.

Au Sable creeks in the early thirties, formed the nucleus of settlement in Grundy County.[33] In Putnam County, immigration "spread over the country in every direction, like a flood, so that nearly every grove of timber soon found an inhabitant."[34] In Bureau County, the earliest settlements were along the timber of Bureau Creek.[35] The northern and western parts of Bureau County, the southern and northwestern parts of La Salle County, and the northern part of Grundy County, are all open prairie, and these sections were not settled until years later. In the rest of the region the expansion of settlement from woodland to the adjacent prairie came about easily and naturally.

## IMPROVEMENT OF THE HOMESTEAD

In all his activities the pioneer had to adapt himself to his new surroundings. Institutions and methods brought from the East were modified to meet the needs of his altered conditions.

The establishment of a "claim" required at first merely that the settler cultivate and harvest a crop, the amount thereof not being specified. "A rail fence of four lengths was often seen on the prairie, the ground enclosed, spaded over, and sowed in wheat."[36] The right to land was secured by its possession. Most of the people living in the region were homesteaders, and they banded together when occasion demanded for the protection of their interests against land speculators. If a settler failed to file a preemption claim, his neighbors saw that he had the opportunity to bid in his land at the minimum price when it was offered for sale. Speculators were handled roughly by settlers if they attempted to bid in improved claims. By the primitive law of the pioneer every settler had a right to the place on which he had located, and anyone who interfered was apt to meet with violence.[37]

The first improvement which the settler provided was shelter for himself and his goods. In a few days he could build a log cabin with the ready aid of his neighbors. "Let a man and family go into any of the frontier settlements, get a shelter or even camp out, call upon the people to aid him, and in three days from the start he will have a comfortable cabin, and become identified as a settler."[38] Cabin raising offered an opportunity to the neighbors for miles around for a welcome holiday to relieve the monotony of the frontier life. In most cases the materials for the cabin were secured on the homestead. Rudely hewn logs were used for the walls, and logs more carefully split provided the puncheon floor, if there was such a

[33]Armstrong, Address at Old Settlers' Reunion, 1876.

[34]Hennepin Journal quoted in Mitchell, Illinois, in 1837, p. 100.

[35]Matson, Nehemiah, History of Bureau County, p. 87.

[36]Baldwin, E., History of La Salle County, p. 131, 1877.

[37]Idem, p. 131.

[38]Mitchell, S. A., Illinois in 1837, p. 68.

luxury. Wooden pins were used instead of nails, and at the corners of the cabin the logs were secured by being notched and fitted into each other. Cracks in the wall were chinked with clay. The chimney was generally built of timber and plastered inside and out with a mortar of sand and clay. Furniture and utensils were homemade. Bedsteads commonly were built into the corners of the cabin, and were of the most simple construction.[39]

Breaking the sod was a long and arduous task for the early settler. The sod was strong and heavy, the plows were weak and clumsy, and his stock was generally in none too good condition. The earliest practice consisted in hitching six to ten yoke of oxen to a plow that cut a furrow two to three feet wide.[40] To the plow was attached a heavy plow beam, framed into an axle and supported by clumsy wheels cut from oak logs. These unwieldy plows fortunately soon were supplanted by the light highly polished shear-plow which slipped through the heavy sod like a knife.[41] The improved plows turned up a strip of turf 18 to 24 inches wide, required only three yoke of oxen, and effected a considerable saving of time.[42]

Wild prairie grasses furnished food for the live stock until the first crop was raised. They tided many a farmer over the period while he was breaking the ground and growing his first crop and was without other food for his work animals. The wild grasses made excellent hay, especially those which grew on low ground.[43] Patches of prairie grass were often kept for pasturage, but commonly they were killed out in a few years, as they were not well adapted to grazing.

The first crop planted was almost invariably corn. The first year's yield was known as ''sod corn'' and made about half an average crop.[44] Methods of planting were born of the exigencies of the times; in many cases the upturned turf was gashed with an axe, and the seed corn dropped in.[45] After the first crop a harrow could be used, and the ground was put in fairly good shape for the second crop. This was often some small grain such as wheat or barley, though in many fields corn was raised exclusively for many years. On the whole agricultural methods were crude and inefficient. As land was to be had almost for the asking, and anyone could grow enough to support himself and family, careful husbandry was not necessary. Wheat, for instance, was sowed among the corn stalks of the

[39]Baldwin, E., History of La Salle County, p. 134, gives an animated description of the building of such a cabin.

[40]Idem, p. 136.

[41]Curtiss, D. S., Western portraiture, p. 291, 1852.

[42]Beck, quoted in Mitchell, Illinois in 1837, p. 14.

[43]Baldwin, E., History of La Salle County, p. 171, 1877.

[44]Beck, quoted in Mitchell, Illinois in 1837, p. 14.

[45]Baldwin, E., History of La Salle County, p. 137, 1877.

previous summer's growth. It is said that the crops produced were on the average not more than half as large as they are today.

Agricultural machinery came into general use before 1850. Drills and harvesters were among the first to be introduced, and soon were used almost universally. By 1850 mowing machines and threshers had proved successful.[46] The use of farm machinery spread much more rapidly in this section than it did in the Eastern States, for labor was difficult to secure as long as homesteads were waiting for entry; also the nearly level prairie surface made farming by machinery particularly easy and profitable.

As long as large areas of prairie grass remained, there was great danger of prairie fires. "From the first frost until spring, the settler slept with one eye open, unless the ground was covered with snow."[47] Until most of the land had been put into cultivation, it was customary to protect the farm buildings by plowing a strip about the farm yard, to save the buildings, if not the crop.

The cost of securing a homestead and improving it was not great. In many cases the only cash expended was the fee of $1.25 per acre paid to the land office. Breaking the prairie sod was estimated to cost about $2.00 an acre. The cost of fencing was greater than the initial cost of the land. Cabin and outhouses cost little or nothing, if timber was close at hand. It was estimated by contemporary writers that a quarter section could be bought and improved for $1,000 or less.[48] The opportunities were unsurpassed for men of limited means who were willing to bear hardships and could labor patiently.[49]

### FARE OF THE PIONEER

For a number of years the settler was limited virtually to the produce of his farm, as markets were inaccessible, and as he had no means of disposing of his surplus. His food was simple, but sufficient. Cornmeal, hominy, potatoes, and pork comprised his bill of fare; later, wheat flour was added. The first industry established in the region was grist milling. The first mill was built at Dayton in 1830, and for a short time its nearest competitor was the mill at Peoria.[50] Soon a second mill was built on Indian Creek,[51] and in 1841 a large grist and flour mill was built at Marseilles on Illinois River. These mills supplied the central part of the upper Illinois and the lower Fox River country. In the early thirties grain was shipped from Bureau County for grinding. In the eastern part of the

[46]Curtiss, D. S., Western portraiture, p. 291, 1852.

[47]Baldwin, E., History of La Salle County, p. 145, 1877.

[48]Mitchell, Illinois in 1837, pp. 14 and 69.

[49]Hunt's Merchants' Magazine, vol. 3, p. 35.

[50]Kett, Past and present of La Salle County, p. 182.

[51]Keyes, Directory of La Salle County, 1872, Introduction to Dayton Township.

region a mill was built at Channahon in 1837. In many places no grist mill was accessible, and the settler or, more often, his wife, ground the meal by hand, generally by pounding corn in the mortar.[52] Bad weather and bad roads forced many a family to live for weeks on meal prepared in this manner.

There were times when crops failed and provisions had to be shipped into the region. This was difficult and tedious, and famine came close to many homes at such times.[53] Food is known to have been brought from points hundreds of miles distant. It is related that at one time two men traveled to central Illinois, a distance of almost 200 miles, to buy corn, have it ground, and bring it to the upper Illinois settlements. On another occasion a keel boat was sent down the Illinois to the settlements on Sangamon River to buy grain for the settlers about Ottawa.

### INSTITUTIONS AND SOCIAL LIFE

Unlike the settlers from the South, the Northern pioneers of this area came from a densely peopled region in which farms were small, and in which many of the people lived in villages or towns. They had, therefore, developed social institutions to a more advanced form than their Southern neighbors. Church, government, and school were transplanted from New England to the prairie home. A number of colonies brought their minister, almost invariably Congregational, and most of them erected a house of worship almost as soon as they had built their cabins. Schools also were valued highly. In 1828 a "select" school was organized at Ottawa, and in a few years a log school house stood by the side of the log meeting house, and both were attended with equal zeal. The first courthouse and jail were built at Ottawa in 1830,[54] three years after the first election had been held. The township government of this part of the State is also a Northern institution, imported bodily.

Pioneer days offered little opportunity for social contact. Settlers were few and scattered widely, roads often were impassable, and the task of improving the homestead required unceasing attention. Pioneering was especially hard on the women, who were kept at home almost constantly by their household duties. The isolation and monotony of pioneer life broke down many settlers, or impaired seriously their working ability. Baldwin, pioneer historian, says that homesickness was a real disease, in some cases a deadly one. "The bodies only of a great many people and not their minds" lived in the country of their adoption.[55] There could be slight progress as long as the heart of a man was still in his eastern

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[52]Matson, Nehemiah, Tax-payers and voters of Bureau County, p. 99, and Baldwin, p. 129.

[53]History of La Salle County, p. 464, 1886.

[54]Keyes, Directory of La Salle County, Historical introduction.

[55]Ford, H. A., History of Illinois, p. 230, 1860.

home, and his mind turned unwillingly to the problems of his new surroundings. Naturally every opportunity to break this isolation was seized upon eagerly, and holidays were celebrated with an enthusiasm which seems strange and crude today. Log cabin raisings, elections, political campaigns, corn-husking bees, and above all camp meetings—these were the entertainments of the pioneers. To these simple pleasures the people looked forward eagerly, and from them they drew food for later reflection and conversation.

News was scarce and traveled slowly. Stray copies of newspapers were read eagerly for news of the outside world. The first local newspaper was established at Hennepin in 1837. Two years later, a weekly sheet began publication at Peru. In 1840 the *Ottawa Free Trader* was established. It was not until 1852 that a newspaper was started in Grundy County; at this time half a dozen papers were issued in the upper valley. Because of the devious and slow means of communication and consequent lack of news these early papers were filled largely with poetry, essays and stories. The few local happenings were supplemented by clippings from the metropolitan papers whenever they could be secured. The early local sheets published particularly news from the St. Louis dailies brought by boat. In the forties, European news was generally five weeks old, and news from the Atlantic coast two weeks old. Harrison's death, for instance, was reported as a rumor after twelve days, and confirmed after nineteen.[56] In the press, as in all other social institutions of the day, the isolation of the pioneer finds expression as the dominant feature of his life.

## HEALTH CONDITIONS

The Prairie States, notably healthful now, once were reputed very unhealthful. This early opinion was in part superstition based on a general distrust of the prairies. That sickness, however, was much more prevalent in the pioneer days than at present, is well known. Among the early settlers the few physicians and consequent lack of medical attention may be assigned as one reason. Most of the settlers were ignorant of hygiene and neglected the drainage and sanitation of their premises. The nearly level prairie afforded little or no natural drainage, so that often the accumulated refuse of the farm polluted the water which the settler drank and the air which he breathed. Climatic conditions were new and strange, and it took the settler some time to adjust himself to them. Finally, the prairie itself probably bore the seeds of sickness to a greater extent than it does today. There were many stagnant pools of water, and most of the soil was ill drained. Under such conditions malaria, typhoid, and similar fevers were prevalent.

[56] Ottawa Free Trader, volume for 1840.

"Fever and ague" were the scourge of the pioneer and were thought generally to be caused by the breaking of the prairie sod from which were said to issue "poisonous miasmas," especially in late summer and fall. Chills and fever broke up the Northampton colony near La Salle. The summer of 1838 was marked by an exceptional amount of sickness; in the river towns nearly all were sick and many died, and at La Salle there were said to be 300 graves in the fall on which it had never rained. A heavy spring flood followed by extreme heat in August is said to have favored the development of disease from the backwater of the river.[57] When the farmers learned to build away from marshes, on elevations with natural drainage, their health improved greatly.[58] As the ground became cultivated, the surface drained, and the farms supplied with well water, malarial fevers tended to disappear, and the evil reputation of the prairies gradually was forgotten.

## TRANSPORTATION

During the first years, the settler found neither time nor urgent need for the construction of transportation lines. Until he had improved his homestead and won from it a living, he could not give attention to means of communication. As long as his farm yielded no surplus, the pioneer had scant need of markets in which to exchange his products. These were the days of home-made products, from food to clothing. A few primitive stores supplied tools, tobacco, drugs, and the other articles which the simple needs of the people demanded. During this period the only highways were those furnished by nature—streams and the level surface of the prairie—and for a time they were reasonably adequate.

Illinois River was the first great highway of this part of the State, and by it the first settlers came into the region. In 1825 a man named Walker came up the Illinois in a keel boat as far as Ottawa[59] and for the next decade Illinois River furnished the principal connection with the world outside. The upper river was of some importance commercially until about 1860, but after 1848 it served chiefly as a feeder to the Illinois and Michigan Canal. The earliest river traffic was carried by log canoe, keel boat, barge, and raft. These craft usually were home made, and were used only to float produce down stream, although an occasional boat, laden with provisions from the South, was towed against the current. Before 1820 steamboats had been adapted to the needs of navigation on inland rivers, but not until 1831 did the first steamboat penetrate to the upper Illinois Valley. For several years afterward only an occasional boat ventured above

[57]Baldwin, E., History of La Salle County, p. 159; also, Baskin, History of Grundy County, p. 151.

[58]Mitchell, Illinois in 1837, p. 69.

[59]Introduction to Directory of La Salle County, 1858-1859.

Peoria.[60] Ottawa was the absolute head of navigation, but except in time of flood boats could not pass the rapids above Utica. Even Utica was not a satisfactory shipping point because of the bars built into the Illinois below it by the Vermilion rivers. Most of the steamboats, therefore, stopped at Peru, which became the chief river town of the upper valley. It was located where the stream washes the base of a high terrace on the northern side of the valley. The site afforded good landing and protection from floods. Depue was the other river town of this region. Illinois River was never of such importance to the people of this section as to the people of the middle and lower valley. Little mention of steamboating or river traffic is made, either in the press of the day, or in local history. The bars and rapids of the river cut off the eastern two-thirds of the region from the benefits of river transportation. In 1848 the Illinois and Michigan Canal diverted the trade of the region eastward, and thereafter a large part of the river traffic consisted of through cargoes from the South and West, shipped to New York by way of the canal.

Wagon trails across the prairie were used considerably. The earliest traces followed Indian trails, beaten paths a foot or two wide in the sod.[61] Several of the early roads were originally mail routes. In 1828 Kellogg's trail was laid out from Peoria to Galena and along it were made the first settlements in Bureau County, namely, Senachwine, Boyds Grove, and the settlements on Bureau Creek.[62] In 1832 a mail route was established from southern Illinois to Chicago via Decatur, Ottawa, and Fox River. A few years later the settlers began to haul their surplus products to Chicago, and in the middle thirties a number of roads were worn by the loaded market wagons. It was at this time that the Bloomington-Chicago road, which passed through southern Grundy County, began to be outlined by the droves of live stock going to market and the return teams hauling salt and supplies.[63] In the thirties also a road from Ottawa to Joliet and Chicago was established. Such a road, once fixed, was followed carefully, as it was easy to get lost, or at least to wander from the direct road on the featureless prairie.[64] After rains, and during the spring thaw, the roads often became impassable for weeks at a time. Bridges were unknown in this part of the State, and streams were crossed at fords. At times streams in flood isolated whole settlements from outside communication, and even caused loss of life. It is recorded[65] that before a bridge was built across the Big

[60]Ford, H. A., History of Putnam County, p. 96, 1860.

[61]Baskin, History of Grundy County, p. 152.

[62]Matson, Nehemiah, History of Bureau County, p. 87.

[63]Baskin, History of Grundy County, p. 155.

[64]Baldwin, E., History of La Salle County, p. 140-141, tells of misleading mirages, of pioneers who lost their lives on the prairie during the winter, and of other adventures of the prairie traveler.

[65]Idem, p. 140.

Vermilion twenty-five people were drowned while attempting to ford the stream in flood-time. But crude as were these trails and the conveyances that creaked upon them, they afforded the settlers a means of communication, and the pioneers of eastern La Salle and Grundy counties an outlet to the eastern market.

## Boom Days and Their Collapse

Like most promising countries, this region passed through a period of exaggerated enthusiasm for its own future, a period in which "possibilities appeared highly probable; and probabilities wore the livery of certainty itself."[66] The boom days began in 1835, several years after settlement began in force, and at the time when the opportunities of the country first began to be generally appreciated. Eastern people and Eastern capital flowed into the country as never before. Once started, the spirit of speculation fired the imagination of settler and investor alike, and few did not dream of fortunes to be made over night. Values were inflated to an almost incredible extent, and the feverish optimism of the fortune hunter blurred the commonly clear vision of the pioneer and business man.

Farm values increased tremendously, but speculation concerned itself especially with town-site real estate. Chicago became the great market for town lands; plats of towns for many miles around were auctioned off constantly, and they are mentioned as Chicago's chief "article of export" in 1836.[67] A cross-road furnished an ideal and rarely neglected opportunity for locating a town, and great cities were to be built in the prairie where there was neither road nor river.[68] Towns already in existence saw themselves destined to become great cities. Peru was heralded as a rival of Chicago for the control of the interior. The following extracts are from a contemporary letter to the *Pennsylvania Inquirer:* "This place will unquestionably become one of the greatest inland towns in the West, and second only to Chicago. A traveler riding through would smile if you were to tell him that this place was destined to become a city. One humble tenement is all it boasts, and a stranger would be apt to imagine when you told him that a town was laid out there, and that lots were commanding from $1,000 to $2,500 apiece that the speculative fever was raging with all-pervading influence. And but a few short months ago, the land there, was entered for a dollar and a quarter per acre—now it will readily command from 5,000 to 10,000 dollars per acre. * * * * Come then and view this rich, this growing, this flourishing country—examine its resources. See the field that is opened for enterprise and talent. * * * * My word for it, a

[66]Ford, H. A., History of Illinois, p. 183, 1860.

[67]Ford, H. A., History of Illinois, p. 181, 1860.

[68]Baldwin, E., History of La Salle County, p. 174, relates how a young orchard of his was mistaken repeatedly as the site of a new city.

city life will lose its charms and you will, without a sigh bid it farewell, take up your staff and come and pitch your tent in the great, the growing, the mighty, the boundless West.''[69] The falls of the Illinois were to make of Marseilles a second Lowell or Fall River. Channahon, at the confluence of three streams, none of which was navigable, was to become a great junction of commercial routes. Wild as were these speculations, they pale before the projects of towns that never existed. In most cases their very names are forgotten. The names of a few of them have been preserved, among them Gibraltar, which was to occupy the site of Starved Rock, perhaps in anticipation of the future profits of the summer resort, Kankakee City, Dresden, and Three Rivers. There are not six houses today on the sites of all these places, yet lots of Kankakee City are said to have been sold in Chicago and New York for thousands of dollars. The town which was laid out at the mouth of the Kankakee River, was to cover 2,000 acres, with broad avenues and ten public squares. Plats of this projected city were distributed broadcast over the country, resplendent ''with magnificent buildings, busy with the traffic of capacious warehouses and crowded steamboat wharves;''[70] on waters which have never even felt the churn of a paddle wheel.

The chief cause underlying the land boom of the middle thirties in this section was the fertility of the soil. The new country to which the settler came had a soil better far than most of the land in his eastern home. Larger crops could be raised with less labor; land was cheap and the amount of unentered land seemed unlimited. The great agricultural possibilities suggested the opportunity for the development of prosperous cities. All that was necessary was to begin such a city, and the the resources of the land would guarantee its growth. Enthusiasm mounted higher and higher, and by mutual stimulation soon passed the bounds of prudence. Letters carried east the praises of the new country, and they grew in telling, until the western prairie appeared to contain immeasurable possibilities.

Another cause lay in the high prices which prevailed for a time. During the first years of settlement the crops grown were insufficient to feed the settlers and the emigrants who were pouring into the country. As a result crops brought high prices. From 1833 to 1837 wheat sold as high as $2.00 per bushel, and corn and oats for $1.00 to $1.50.[71] In Bureau County wheat brought $2.50 per bushel in 1836, corn $1.00, and flour $16.00 per barrel. Grain was shipped up the river from central Illinois to supply the demand and cattle and sheep were driven in largely from the southern part of the State.[72] As long as immigration kept up the demand, prices

[69]Quoted in Mitchell, Illinois in 1837, pp. 135-6.

[70]Baskin, History of Grundy County, p. 320.

[71]Baldwin, E., History of La Salle County, p. 110, 1877.

[72]Matson, Nehemiah, History of Bureau County, p. 103.

remained high, and the settlers enjoyed a prosperity whose cause they did not fully understand, but which helped greatly to inflate values.

Partly a cause of the local boom and partly its result was the glittering scheme of internal improvements launched about at this time. This movement shortly became the most important issue in the State, and later almost bankrupted the commonwealth. The handicap of insufficient means of transportation was felt, and it was realized that improved communication with the eastern and southern markets was absolutely necessary. Popular sentiment accordingly demanded the construction of various lines of transportation to the great seaboard markets, with local feeders throughout the State. The enthusiasm for internal improvements soon seized hold upon the legislators, especially those from the central and northern counties. As early as 1835 Governor Duncan expressed "a laudable ambition to give to Illinois her full share of those advantages which are adorning her sister states, and which a munificent Providence seems to invite by the wonderful adaptation of our country to such improvements."[73] In the spring and summer of 1836 resolutions were passed at mass meetings in various parts of the State, declaring that the resources of the State could be developed only by extensive improvements, and that these would pay for themselves by the capital which they would attract to the country. In October, 1836, an Internal Improvement Convention was held, and "the most wild calculations were made of the advantages of a system of internal improvements; * * * * and of our final ability to pay all indebtedness without taxation."[74] In February, 1837, the Legislature appropriated $10,230,000 to be expended in the construction of internal improvements other than the Illinois and Michigan Canal. This sum was voted without previous surveys, without even an approximate idea of the cost of the work to be undertaken. The money was appropriated (1) to secure better communication with the southern markets, especially with New Orleans, by the improvement of the navigable streams of the State; and (2) to build cross-State railroads from north to south and east to west for the purpose of connecting points at opposite ends of the State, between most of which there was neither trade nor the prospect of large trade. The only really important improvement of the day was begun somewhat earlier and had been provided for separately; this was the construction of the Illinois and Michigan Canal, to unite the Lakes and the Mississippi system. For a brief period the glittering scheme of internal improvement gilded the future with promises of an assured and immediate prosperity.

The upper Illinois country participated in all these projects: (1) It was to receive a share of the $100,000 appropriated for improving the navi-

[73]Governor's Message, December 7, 1835.

[74]Ford, H. A., History of Illinois, p. 183. 1860.

gation of Illinois River. (2) The western terminus of the Illinois and Michigan Canal was to be located in La Salle County. (3) The great Central Railroad projected to run from the Wisconsin State line to Cairo was to cross the western terminus of the Canal. (4) Putnam County received a cash bonus of about $9,000 from the consolation money distributed among the counties left without internal improvement.

The boom days were brought to a sudden and disastrous end by the panic of 1837. These hard times were caused by morbid economic conditions throughout the country, and were aggravated by the situation in the State. (1) Speculation in its grossest forms had lured individuals and banking institutions far beyond the safety line of reliable assets. (2) As the new settlers filled up the region, and began to produce large crops, the local markets were glutted, and foreign markets were not easily accessible. After 1837 there was a considerable surplus of grain and livestock in the upper Illinois country, and the price of farm products fell to the prices at the eastern markets less the transportation charges, which reduced their value below the price of profitable production.[75] The farmers of eastern La Salle County hauled considerable grain to Chicago in these years. Bureau County shipped down stream, especially to St. Louis, although some grain was hauled even from here to Chicago.[76] The desperate conditions are strikingly illustrated by this haul of 120 miles, which some of the Bureau County farmers made to dispose of their products for the barest necessities of life. Wheat sold as low as 25 cents a bushel. Pork brought $1.50 per hundred in Bureau County. In La Salle County wheat sold for 30 to 40 cents per bushel, corn for 10 to 15 cents per bushel, eggs as low as 3 cents a dozen, and cheese and butter at 5 cents a pound.[77] (3) Many towns had bonded themselves heavily, relying upon a sufficient increase in population to meet their liabilities. When their expectations were not realized, some of them were forced into bankruptcy. (4) The State engaged in many improvement schemes which were scarcely started when the original appropriation was exhausted. By 1840 the State had accumulated a debt of $14,237,348[78] and had succeeded only in getting the canal well under way, and in building a few short and unimportant stretches of railroad. The State lands, located along the railroads and the canal, had not sold to the extent anticipated, and the increase in revenues from the property of new settlers had not materialized as had been hoped. In this year, the revenues of the State were less than one-seventh of the annual interest

[75]Baldwin, History of La Salle County, p. 175, 1877.

[76]Matson, Nehemiah, History of Bureau County, p. 103.

[77]Kett, Past and present of La Salle County, p. 194.

[78]Davidson, Alexander, and Struvé, Bernard, History of Illinois, p. 448.

on the State debt. In 1841 payment of interest was stopped entirely, and the bonds of the State dropped to 18 cents on the dollar.[79]

The results of the collapse were: (1) the ruin of the credit of the State, attended by an utter demoralization of financial conditions and the disappearance of coin from circulation; (2) the abandonment of all the improvement enterprises; (3) the stranding throughout the State of a great number of laborers who had been engaged in building various transportation routes; (4) the stoppage of immigration. Emigrants naturally avoided a State so burdened with debts that it appeared impossible for it ever to free its inhabitants from intolerable taxation. Many people left the State and for several years the development of Illinois seemed permanently blasted by its visionary schemes of improvement.

In 1842 a conservative administration, headed by Governor Ford, began the rehabilitation of the credit of the State. The Illinois and Michigan Canal was completed as the most promising of the projects undertaken, and the others were abandoned. By the middle forties payment of the public debt was resumed, immigration sought the State once more, and the development of its natural resources began again.

## Illinois and Michigan Canal

### CONSTRUCTION

Near[79a] Summit, the Desplaines River approaches within three miles of the South Branch of the Chicago River, and the watershed is so low that in wet seasons it has been obliterated entirely at times. Boats have passed from Lake Michigan into Chicago River, and thence to the Desplaines, Illinois, and Mississippi rivers without unloading. Caton tells of such a trip from Chicago to the Desplaines made in 1833 in a canoe. Others report that at times boats of 18 tons were floated across this divide.[80]

The ease with which a canal might be dug to join the lakes and Illinois River, and with which it could be supplied with water from Lake Michigan, directed the minds of people to projects of this sort at an early date. Joliet and Marquette saw the possibility of opening such a canal as they portaged across this divide for the first time. At the beginning of the nineteenth century, a canal was recommended for military purposes. In 1814 President Madison advocated such a canal to provide a way to reach the interior, and Secretary of War Calhoun made a similar recommendation in 1819. In 1827 Congress donated to the State every alternate section within five miles of the proposed canal, in all about 325,000 acres.[81] In 1829 the

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[79]Idem, p. 451.

[79a] For a good discussion of this canal see also Barrows, H. H., The Middle Illinois Valley, Illinois Geol. Survey Bull. 15.

[80]Hoffman, C. F., A winter in the West, vol. 2, p. 21, 1882.

[81]Preliminary Report Inland Waterways Committee 1908, pp. 178-247.

construction of a canal under State authority, to join Lake Michigan and Illinois River, was authorized. Shortly after, a new survey placed the estimated cost at approximately $4,000,000.[82] In 1834 a preliminary loan was made by an issue of State bonds, and in 1836 work began. A year later the panic came, and in 1839 work was suspended entirely.[83] The State was unable to pay its canal debts in specie, and commenced issuing scrip. By 1843 almost $5,000,000 had been expended; and in this year the project of a lake level canal was abandoned for a shallow cut canal with numerous locks to save expense in construction. By arranging a transfer of property to its bond holders the project was carried to completion. When the canal was transferred, its affairs were in an utterly demoralized condition, as shown in the following tables of values of canal scrip:[84]

Apr., 1840, value generally at par.
May, 1840, 70 cents on the dollar.
Dec., 1841, 40 cents on the dollar.
Dec., 1842, 28 to 33 cents on the dollar.
Jan., 1843, 16 to 20 cents on the dollar.
1845, 30 to 32 cents on the dollar.
1847, 35 cents on the dollar.

The canal was completed in 1848, and the first boat was let through the locks on April 23, amidst public celebration all along the route.

### TRAFFIC

For a number of years the canal handled almost the entire east-west traffic of northern and central Illinois. Figure 63 shows the chief commodities carried during the first ten years of its operation, and the changes in their relative importance. They fall into four general groups: (1) commodities chiefly shipped out, as grain, coal, pork, and lard; (2) commodities chiefly shipped in, as lumber, siding, shingles, laths, salt, railroad iron, and foundry products; (3) articles of local commerce, transferred for short distances along the canal, as sand, earth, and stone; and (4) through freight. For the shipment of the last group of commodities, the canal was used as a link especially in the trade between the South and the Atlantic Northeast.

Of the commodities shipped out, corn speedily came to be far and away the most important. Before the canal was opened, wheat had been grown almost as extensively as corn. The cheap transportation afforded by the canal made it advantageous to produce the bulkier grain on the heavy, rich prairie soil, and wheat soon became a subordinate crop in upper Illinois

[82]Report of Canal Commissioners to the Senate of Illinois, 13th General Assembly, pp. 1-8.

[83]Baldwin, E., History of La Salle County, p. 175, 1877.

[84]Report of Abraham Lincoln and M. Johnston to the Twentieth General Assembly, First Session.

Valley. Next to corn and wheat, but in much smaller quantity, coal was exported most largely. In the earliest years of the canal, coal mining in this region was still in its infancy. Later the traffic in coal was secured by the railroads, so that this commodity was not long prominent in the canal traffic.

Of the articles shipped in, lumber ranked first, and was of slightly greater importance in the canal traffic than corn. Lumber, lath, and shingles for buildings, posts and poles for fences, and cord wood for fuel were prime requisites in the development of the prairie. Until these could

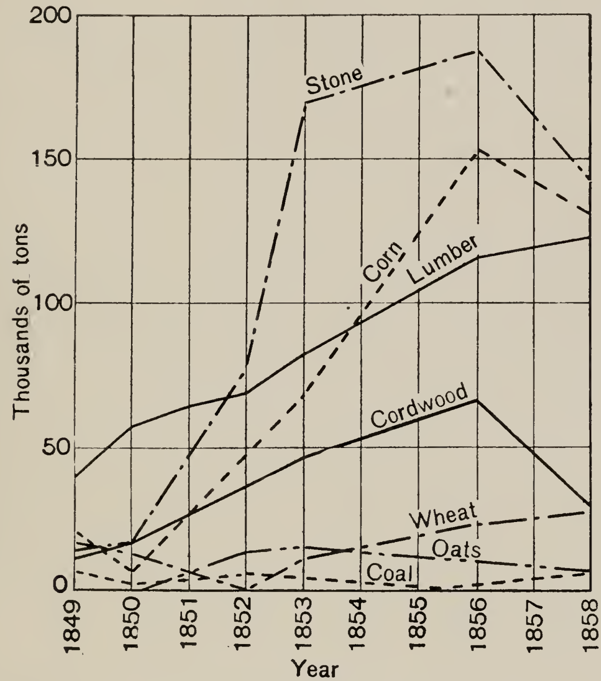


FIG. 63.—Graph showing chief commodities carried on the canal from 1849 to 1858.

be supplied, the settlement of much of the prairie was impracticable. Lumber could be secured near the Great Lakes in Michigan and Wisconsin at very low prices and could be shipped to Chicago cheaply by boat, but the cost of transportation inland by wagon was so great that, until the canal was opened, it was cheaper to ship lumber from New York and Pennsylvania down the Allegheny and the Ohio rivers and thence up the Mississippi and Illinois rivers to Bureau or La Salle County, than to bring it from Chicago.[85] In 1837 pine lumber sold for $50 to $60 per thousand at St. Louis,[86]

[85]Hunt's Merchants' Magazine, vol. 41, p. 695.

[86]Jones, A. D., Illinois and the West, p. 207, 1838.

and for considerably more in the upper Illinois country. The great pine forests of Michigan and later those of Wisconsin furnished Chicago with lumber at prices much lower than those which prevailed in central Illinois. Chicago became a large lumber market even before the opening of the canal. The latter, however, furnished it with an almost unlimited outlet to the prairies of the middle West. The receipts of lumber in Chicago in 1848 were 60,009,250 feet, as against 32,118,225 feet in 1847.[87] This means that in the year in which the canal opened the receipts almost doubled; in another decade they had increased tenfold. For years Chicago was the world's greatest lumber market, and it lost this position only when lumbering declined in the Great Lakes region. The capital attracted by the lumber trade stimulated the growth of Chicago and established many other wood-using industries. This trade was built largely on the demands of the prairies, which were first made accessible by the canal. To the canal, therefore, belongs much of the credit for the earlier development of Chicago. The first canal boat which came to Ottawa carried lumber, and this boatload reduced the price of lumber there from $60 to $30 per thousand and later shipments lowered the price still further. From 1848 on, lumber could be had for all purposes. Log cabins ceased to be built, and for many years frame houses were constructed, almost to the exclusion of brick and stone. Merchandise was an important item in canal traffic until 1853, when the first railroad in the upper valley was built. In transporting merchandise, time was a more important element than in the transportation of most other commodities, whereas freight charges were less important. It was natural, therefore, that high-priced merchandise should be handled almost immediately by the more expeditious railroads, while the bulkier commodities continued to be moved largely by canal. Railroad iron formed an important article of import during the middle fifties, while railroads were being built in the territory contiguous to the canal and the Illinois River. Salt was a prime necessity which had to be imported, and which could be brought from the salines of New York more cheaply than it had been shipped in previously from the Ohio River salt works by way of the Mississippi and Illinois rivers. The cheaper salt which the canal brought in stimulated the development of stock raising in this country.

Of increasing importance in the traffic of the canal were short-distance hauls, by which bulky products were transported from point to point within the region. Much sand and gravel from pits along Illinois Valley was handled in this way. In the latter half of the first decade of canal traffic, stone was its most important item, and was used chiefly for the extensive railroad construction of those years.

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[87]Hunt's Merchants' Magazine, vol. 40, p. 229.

In the early years, through shipments were prominent among the items of canal traffic. Grain from farther west was shipped in large quantity through the canal. For some years nearly all the lumber shipped to central Illinois and Iowa passed through the canal and down Illinois River, to be distributed to the prairie settlements of the middle Mississippi Basin. The Mississippi and Illinois rivers, the canal, and the Great Lakes formed a great route for the shipment of goods from the lower Mississippi Valley to the east, and vice versa. In 1849, 3,973,145 pounds of sugar, 3,659 gallons of molasses, 173,407 pounds of tobacco, and 307,861 pounds of hemp were cleared at La Salle. Curtiss[88] writes in 1852 that "merchandise of almost

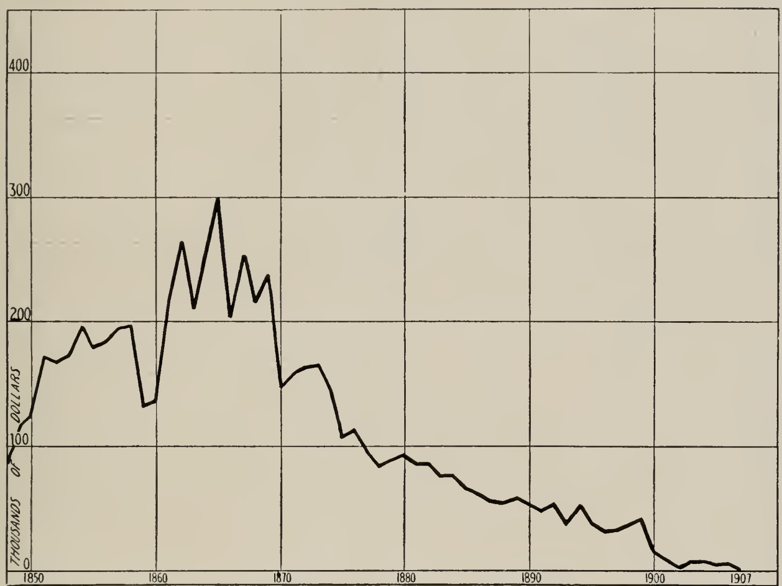


FIG. 64.— Graph showing tolls collected by Illinois and Michigan Canal from 1848 to 1907.

every description, passing from the East to the Illinois, Mississippi, or Missouri rivers, are now forwarded by way of the Lakes and the Illinois and Michigan Canal. Within a short time past, we have noticed large consignments coming up the Lakes, *en route* for the St. Louis market. * * * * A late number of the *St. Louis Intelligencer* notices the arrival at that place of a canal boat load of Porto Rico sugar, which had been brought through from New York. * * * * The *Albany Evening Journal* says: A canal boat is now in the basin * * * * laden with cotton, being the fourth which has brought this staple from the West this season."

[88]Curtiss, D. S., Western portraiture, pp. 47-48.

The gradual changes in the character of the canal trade are shown in figures 64 and 65. The maximum tonnage was not reached until 1882, but canal tolls declined after 1865. This condition was due chiefly to three reasons: (1) The competition of the railroads forced a reduction of the toll on almost all articles, as shown by the following table:

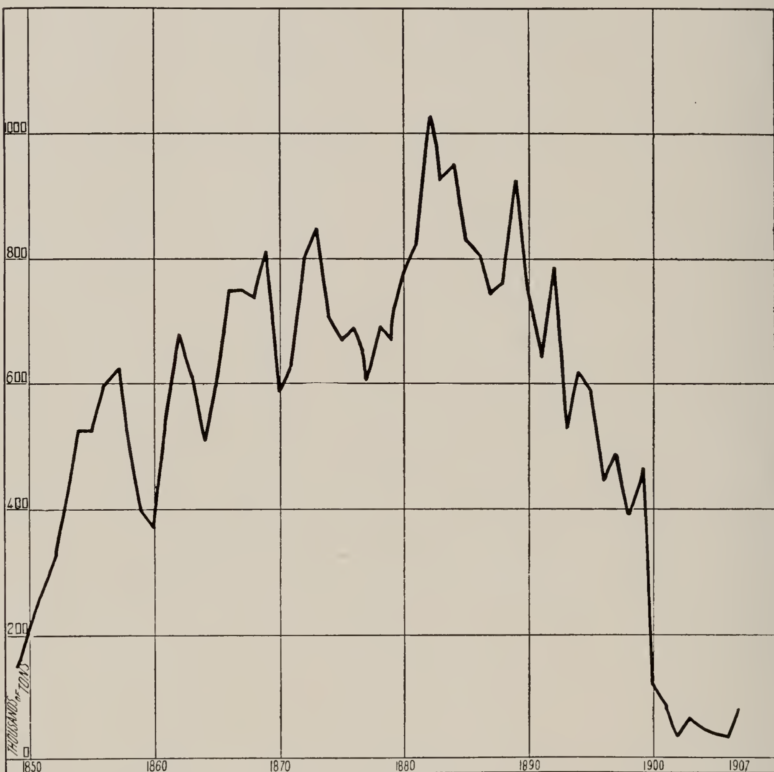


FIG. 65.—Graph showing tons transported on Illinois and Michigan Canal from 1849 to 1907.

| Tolls charged per mile | 1851 | 1856 |
|---|---|---|
| | *Cents* | *Cents* |
| Freight boats, each | 3.50 | 2.00 |
| Passenger boats, each | 6.00 | 3.00 |
| Animals, per 1,000 lbs. | 0.75 | 0.30 |
| Corn, do | 0.03 | 0.03 |
| Furniture, do | 1.00 | 0.80 |
| Merchandise, do | 1.20 | 0.50 |
| Machinery, do | 1.00 | 0.50 |

(2) The railroads carried freight with much greater speed than did the slowly moving canal boats, and as a result the canal lost most of its high-priced freight, in moving which the saving of time was important. This kind of freight, such as merchandise and furniture, had been especially profitable because of the relatively high tolls which had been charged. The traffic that remained to the canal was limited to the transportation of bulky, cheap commodities. (3) The length of the average haul was cut down gradually, and this helped to reduce the tolls. The canal traffic depended increasingly upon hauls too short to be profitable to the railroads. For through hauls, the railroads in most cases offered inducements with which the canal could not compete. The increase in tonnage from 1854 to 1882 is largely an increase in short-distance hauls.

Passenger traffic on the canal was short-lived. During the first four years of its operation, packet boats plied regularly between Chicago and Peru, and made the trip in about 20 to 24 hours—a little less than the time required by the stage coaches.[89] The fare by packet was $4, and by freight boat, $2 to $3; this was regarded as low at the time. At Peru the packets connected with steamboats for St. Louis, which carried passengers to the latter place for $3 to $5. In its first years the canal served both local and through passenger traffic. In 1851 the highest mark was reached with 3,411,504 passengers. The following year 2,630,713 passengers were carried, the great majority for short distances; and in 1853, the year in which the first railroad was completed, the packet boats were sold, and the traffic abandoned. Even less than in fast freight could the canal compete with the railroad for the passenger trade, for the railroad provided transportation in one-fourth the time required by the fastest packet, and at one-fourth less cost. The newspapers withdrew the favor they had bestowed so liberally on the genteel packet, and henceforth sounded the praises of the "iron horse." The canal gave way in public interest to the railroad, and in a single season became an antiquated means of communication.

## SERVICES OF CANAL

In several ways the canal was of great service in building up the region served by it:

1. The canal provided a choice of markets and secured to the farmer profitable prices for his products. Previously most of the produce had to be shipped downstream to St. Louis and New Orleans and had to compete with crops produced nearer to these markets. Much produce had also been hauled tediously to Chicago. Prices almost always were low in New Orleans, because most of the time the market was glutted.[90] In the upper Mississippi

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[89] Curtiss, D. S., Western portraiture, p. 67.

[90] Ford, H. A., History of Illinois, p. 98, 1860.

Valley surplus products were unsalable at times, except where they could be hauled to some lake port. After 1848 the canal opened up the markets on the lakes and on the Atlantic seaboard. The consumption of agricultural produce always had been relatively small in New Orleans, and the bulk of its receipts was shipped eastward. By means of the canal, the farmer could ship via Chicago and Buffalo to New York, whereas before his produce had traveled a thousand miles south to New Orleans, and thence to New York. The northern route saved practically the cost of shipment from New Orleans to New York. The advantage of the Great Lakes-Erie Canal route was great, because it was (a) far shorter, (b) less dangerous, and (c) more direct. Furthermore, (d) avoidance of the congested and inadequate harbor at New Orleans saved time, and (e) the Lake route obviated the drawbacks of the sub-tropical climate of the Gulf region, in which most agricultural products deteriorated, and many spoiled.

Prices rose with the opening of the canal, and the farmer who had only made a bare living, now sold his crops with profit. The following table shows the prices which were secured in Ottawa in 1856.

| | | |
|---|---|---|
| Corn, | 38–40 cents | per bushel |
| Wheat | \$1.25–\$1.40 | do |
| Oats | 27–35 cents | do |
| Potatoes | 35 cents | do |
| Pork | 5½–6 cents | |

The freight rate for a bushel of grain from La Salle to Chicago varied from 4 to 8 cents and averaged 7 cents.[91] On the basis of 15 cents per ton-mile for wagon haulage, the cost of transportation by wagon from La Salle to Chicago was about 46 cents per bushel. The canal thus effected an average saving of 39 cents per bushel for the crops of western La Salle County, which with an average yield for wheat of 20 bushels per acre, meant an added profit on wheat of \$7.80 per acre, and with an average yield of 45 bushels of corn meant increased profits of \$17.55 per acre. The canal made corn a paying crop in the upper valley, whereas previously it could not be marketed with profit.

By means of the canal and Illinois River, most of the trade of northern and central Illinois that previously had gone to St. Louis was diverted to Chicago. Chicago, which before had struggled with St. Louis for leadership of the intervening region, now went ahead of the latter by leaps and bounds. The struggle became still more unequal as railroads were built west from Lake Michigan, and cut off still more territory that had been tributary to St. Louis.

2. The canal enabled the importation of necessities needed for the development of the region. The lumber trade, already noted, was one of the

[91]Kett, Past and present of La Salle County, p. 196.

greatest aids in the settlement of the prairie, and in the building of towns. Cheaper salt encouraged the growing of live stock. Agricultural implements reduced the labor of farming. Woven goods of all kinds were shipped in and released the farmer's wife from the drudgery of the spinning wheel and the loom. A greater choice of foodstuffs was made possible. Some of the articles which were imported increased the efficiency of the pioneer, and others added to the comforts of his life. The canal was the first great agent to break down the isolation and hardships of pioneer life in the upper Illinois Valley.

3. The canal added to the wealth of the region, by helping to reestablish security in the tottering finances of the State, and by attracting immigrants into business, manufactures, and agriculture, thus stimulating the development of agricultural districts and the growth of towns. Farm prices arose almost as rapidly as in the earlier boom days, but this time the increase was legitimate, for it was based on an increased value of farm crops. In 1857 farm land in La Salle County was worth from $8 to $40 per acre; timbered lands bringing $15 to $90. In Putnam County land which had sold for $12 to $20 an acre in 1848 had risen to $25 to $35, and in Will County wild prairie land which could have been bought in 1848 at the Congressional price, sold for $10.[92] It was estimated in 1857 that farm lands in La Salle County equaled in value those about Columbus, Ohio, and were worth $37.50 per acre more than land of equal quality at Iowa City, Iowa, and $68.75 more than land at Des Moines, Iowa.[93]

4. The canal brought into this region the first considerable foreign element, large numbers of Irishmen being imported to work upon it. They outnumbered at times the native residents in the towns along the canal.[94] During the financial crisis, from 1839 to 1843, most of them were thrown

[92]Gerhard, Frederick, Illinois as it is, pp. 402-3, 1857.

[93]Campbell, A., La Salle, A glimpse at Illinois.

Cost of transporting wheat:

| | *Cents per bushel* |
|---|---|
| Columbus, Ohio, to Cleveland | 10 |
| Cleveland to Buffalo | 4 |
| Buffalo to New York | 12 |
| Total cost | 26 |
| La Salle to Chicago | 7 |
| Chicago to Buffalo | 7 |
| Buffalo to New York | 12 |
| Total cost | 26 |
| Iowa City to Chicago | 19 |
| Chicago to Buffalo | 7 |
| Buffalo to New York | 12 |
| Total cost | 38 |
| Des Moines to Chicago | 29 |
| Chicago to Buffalo | 7 |
| Buffalo to New York | 12 |
| Total cost | 48 |

Values of farm land quoted above computed from these figures on the basis of 6 per cent.

[94]Baskin, History of Grundy County, p. 158.

out of work, and having little or no money, had to stay in this district. The canal contractors paid the laborers in canal scrip, which deteriorated so greatly that it could not be used with profit for anything except the purchase of canal lands. For this, it was accepted at par value. Driven by necessity, many of these Irish laborers bought lands with their scrip, and farmed them after a fashion. Their lands made many of them wealthy in later years. The Irish element, descended from these involuntary settlers, is still numerous in the upper valley, both in the cities, especially in La Salle, and in the country.

5. There had been little opportunity for trade before the canal was built, and towns were few and straggling. The canal, however, opened up trade, and stimulated the growth of local trade centers which collected produce and distributed merchandise for the country about. The growth of the following towns was influenced strongly by the canal:

*Peru* had some river trade when the canal was begun, and it was expected that, as the western terminus of the canal, it would become a large city, rivaling Chicago.[95] In the internal improvement scheme of 1836 it was planned to have the Illinois Central Railroad cross the river here. As the proposed junction of three important transportation lines—river, canal, and railroad—Peru was boomed tremendously during those years. In 1837, the town contained one warehouse and two or three dwellings. In that year, the canal contracts were let, and by the following summer it had 426 inhabitants. The panic set in, and in 1842 less than half that number were left.[96] With the return of prosperity, its growth recommenced, but Peru never realized the future prophesied for it. The railroad project was abandoned after a part of the road bed had been graded. Contrary to expectations, the completion of the canal injured Peru. It is true that Peru was at the western terminus of the canal, but a ''steamboat and canal basin'' was built on the flood plain at La Salle, and this became the actual harbor in which steamers and canalboats mingled for the trans-shipment of goods. The forwarding business, after a long and ineffectual struggle on the part of Peru to retain it, finally settled at La Salle.

*La Salle* was laid out in 1837, and the village throve by the trade of the canal laborers until work was stopped during the hard times. With the resumption of activities in 1843, the settlement grew once more. The completion of the canal and steamboat basin gave it considerable trade, particularly the important grain trade which had gone previously to Peru. A large warehouse and grist mill, erected on the canal in 1848, formed the nucleus about which La Salle's later commercial and industrial interests developed.

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[95]Mitchell, Illinois in 1837, p. 135.

[96]Kett, Past and present of La Salle County, p. 307.

*Utica*, a village originally laid out on the river a mile south of the present site, is said to have been supported by river trade before the canal opened. Utica hoped to secure the terminus of the canal, and its supporters charged that the terminus was placed at Peru because in the Legislature the deciding vote by which the passage of the canal act was secured, belonged to a representative from Peru. The true reason probably is to be found in the difficulty of navigating Illinois River above the mouth of the Vermilion rivers during low water. When the canal was laid out along the base of the bluffs, a mile north of the old village, the latter was doomed. In 1852 North Utica was founded on the canal, and the old village was abandoned. The first hydraulic cement manufactured at Utica was used in the construction of the canal.

*Ottawa* was begun south of the river in 1830 and is now called South Ottawa. The first settlement north of the river, now the city of Ottawa, was made in 1837 when work was begun on the canal. Ottawa always has been dependent largely on the rural trade of La Salle County and controlled an even greater share of this trade before the building of the railroads than it does now. "Before the building of the railroads, as a grain market it probably was not surpassed in the State," and it is said to have handled about four times as much grain in the fifties as in the seventies.[97]

*Marseilles* was an industrial town from its beginning, and depended on the water power furnished by the rapids of the Illinois. In 1836 the Marseilles Manufacturing Company was chartered, and in 1837 a crude log dam was built across the river.[98] In 1841 a sawmill and a flouring mill were in operation. This industrial development was partly in anticipation of the commercial advantages which it was hoped the canal would offer.

*Seneca* was laid out by Crotty, in the year of the completion of the canal, and was known for years as the village of Crotty. Its chief support was and is the grain trade. It shared the grain trade of eastern La Salle County with Ottawa, and long maintained large warehouses on the canal.

*Morris.* Grundy County was organized out of La Salle County in 1841. By the provisions of the act creating the new county, the county seat was to be located on a section of the canal land, halfway between the eastern and the western limits of the county.[99] The town grew slowly during its first few years, due to the financial depression. In 1841 it is said to have consisted of two or three log buildings, a frame store, a small public house, and a few laborers' cabins.[100] Upon the completion of the canal several warehouses were erected, and by 1850 the town had a population of more than 500.[101]

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[97]Baldwin, E., History of La Salle County, p. 225, 1877.

[98]Keyes, Directory of La Salle County, p. 126, 1872.

[99]Armstrong, Address at Old Settlers' Reunion, Morris, 1876.

[100]Turner, E. B., Reminiscences of Morris, 1855.

[101]Baskin, History of Grundy County, p. 108.

*Channahon* was laid out as a village in 1845, although settlers had located on the site a dozen years earlier.[102] During canal days, the village throve splendidly: the Channahon mills did a large business, busy warehouses lined the canal, and the village was the most prosperous place between Joliet and Morris. Channahon controls the mouth of the Dupage River, and lies almost opposite the junction of the Kankakee and the Desplaines. The advantages of this position were thought to assure the development of a thriving city.

It is noteworthy that because the canal was built north of the river the principal parts of all the cities and villages in the valley have developed north of the river. Ottawa, for example, was begun south of the river, but the settlement which was laid out north of the river when the canal was built soon outgrew the older part of the town.

### DECLINE OF THE CANAL

After 1865 the tolls of the canal decreased rapidly, and in 1882 its tonnage began also to decline. Today the canal is unused, except by occasional pleasure craft. It went under in competition with the railroads. Some of these railroads secured the trade previously borne on Illinois River, whose commerce had helped support the canal; one paralleled the canal and took away the trade of the very land which once had belonged to the canal; and others were built on the prairie at no great distance from the valley.

The canal could not survive the competition of the railroads for several reasons:

1. Perhaps the greatest reason is to be found not in the canal itself, but in the unsatisfactory conditions of river navigation. (a) Illinois River was subject to great variation in flow. Unfortunately, also, the period of lowest water during several years in the fifties and sixties occurred in the fall, when the harvested crops were waiting to be shipped. The water of the river was often so low in summer and fall as to make navigation impossible in many places. In some years the bars built into the sluggish main by its tributaries reduced the navigable depth to 18 inches, or even less.[103] At La Salle the bankful capacity of the river is 20,000 cubic feet, yet the average volume of water before the drainage flow was added was 2,820 cubic feet, or less than one-seventh of the capacity of the channel. The average low water volume was 796 cubic feet, or about two-sevenths of the normal flow. In the late summer and fall of almost every year, the river proved troublesome, and in many years navigation was suspended for months at a time. In 1853 the river was so low as to be nearly useless for

[102]History of Will County, 1878, p. 592.

[103]Report of the Canal Commissioners, 1867, p. 51.

navigation from July to December, or during five months of the nine open to navigation. It was estimated that this drought reduced the tolls of the canal almost one-half for the year.[104] Without the traffic brought by Illinois River, the canal was of little more than local importance. (b) Steamboat navigation became more and more hazardous as competition forced rival boats to develop greater speed. Fires and other disasters to steamboats became notoriously common, and insurance charges were raised to almost prohibitive rates on consignments shipped by steamboats. (c) Much of the river trade was carried on by wasteful business methods. Most of the boats were independent steamers, which ran without regard to one another, and without definite schedule. They plied from point to point as they

Fig. 66—Canal boat above Morris, a relic of bygone days.

secured a cargo. Freight rates were unstable and dependent in part on the amount of competition from other boats. Similarly, canal traffic and river traffic were carried on largely without any joint tariffs.

2. The canal was closed every winter for three to four months. During almost one-third the year the canal brought in no revenue, and during this time all the traffic was carried by the railroads.

3. The carrying capacity of the canal was limited; the canal was built too small at the start, and as the region developed this waterway soon became hopelessly inadequate for the transportation needs of the country it served. Its minimum draft of fifty-six inches and locks of seventeen and

[104]Davidson, Alexander, and Struvé, Bernard, History of Illinois, pp. 487-488.

one-half feet length limited the canalboats to a carrying capacity of a little over a hundred tons.

4. The slowness of transportation was another drawback. Towage was almost entirely by animals, the locks were badly crowded and delays were frequent. As already noted, the railroads immediately took away from the canal the profitable passenger service and soon also the higher-priced fast freight, such as merchandise, furniture, and perishable produce, with all of which the saving of time meant the saving of money.

5. The canal could not compete long in the carriage of through freight. This was because most of the goods had to be reshipped at the

FIG. 67.—Locks at Channahon.

termini of the canal from steamer to canalboat or vice versa. In boatload lots freight often was carried through by river, canal, and lake to its destination. But smaller shipments were transferred at La Salle and Chicago with considerable delay and expense. The railroads avoided this transshipment, and thereby effected a saving.

For these reasons the canal crumbled before the competition of the railroad. It served its purpose in the development of the region, and having accomplished that, fell into decay (fig. 66). Today it is a relic of a generation that is gone. With the melancholy exception of Channahon (fig. 67), the region has continued to develop without the canal. Channahon was avoided by railroads, and as a result Minooka ships the grain from the region formerly tributary to Channahon. In Channahon, grass grows in the streets, and empty houses dream of the days when the canal was busy with packets and barges.

## Railroad Building

### ORIGINAL PROJECT

Agitation for railroads began in Illinois before 1830. Scarcely had the feasibility of the steam railroad been demonstrated before enthusiasts saw in it the solution of the transportation problems of the interior. The first railroad projected in Illinois was to be a substitute for the Illinois and Michigan Canal and was proposed by the canal commissioners in 1833. A few years later mushroom projects covered the State with prospective railroads. Many of these were included in the internal improvement plan of the State. Among them was a road to be constructed from the mouth of the canal to the mouth of Ohio River, to be known as the Illinois Central Railroad, so designated because it was to run north and south through the middle of the State. Two other roads, running east and west, were to intersect the north-south road, and were to be called Northern and Southern Cross Roads. It was planned to supply all sections of the State with railroads whether they were needed or not.

### ILLINOIS CENTRAL RAILROAD

The crisis of the late thirties prevented the completion of these plans, but the idea of the Illinois Central Railroad was revived after financial conditions had again improved in the State. In 1850 Congress granted 2,005,095 acres to the State, which the latter in turn donated to a company organized to build a railroad from Cairo to La Salle, with branches to Chicago and Galena.[105] This grant gave to the railroad a right-of-way of two hundred feet and title to every alternate even-numbered section lying within six miles of the trunk road or its branches. For lands already occupied at the time the grant was made, the deficiency was to be made up from the unoccupied even sections within fifteen miles of the railroad. It is said that because of this grant the road was laid out where there was the largest amount of vacant land.[106] For some years the lands granted to the Illinois Central Railroad were a far more important source of revenue than the earnings of the traffic. The road was chartered in 1851, and opened during the winter of 1854-55. At LaSalle the Illinois Valley was spanned in its entire width by a high bridge, an extraordinary feat for that day; the structure required two years for its completion.[107] The Galena branch was completed in the summer of 1855, and the Chicago branch a year later.

[105]Ackerman, W. K., Early Illinois railroads, p. 35.

[106]Davidson and Struvé, History of Illinois, p. 573.

[107]Kett, Past and present of La Salle County, p. 198.

Figure 68 shows the original main line of the Illinois Central with its extension to Galena. As a whole, this line for which so much had been hoped is no longer one of the important trunks of the Illinois Central Railroad. Its most important line now runs from Chicago southward to Cairo, via Mattoon and Centralia. The old main line from Centralia to Cairo has

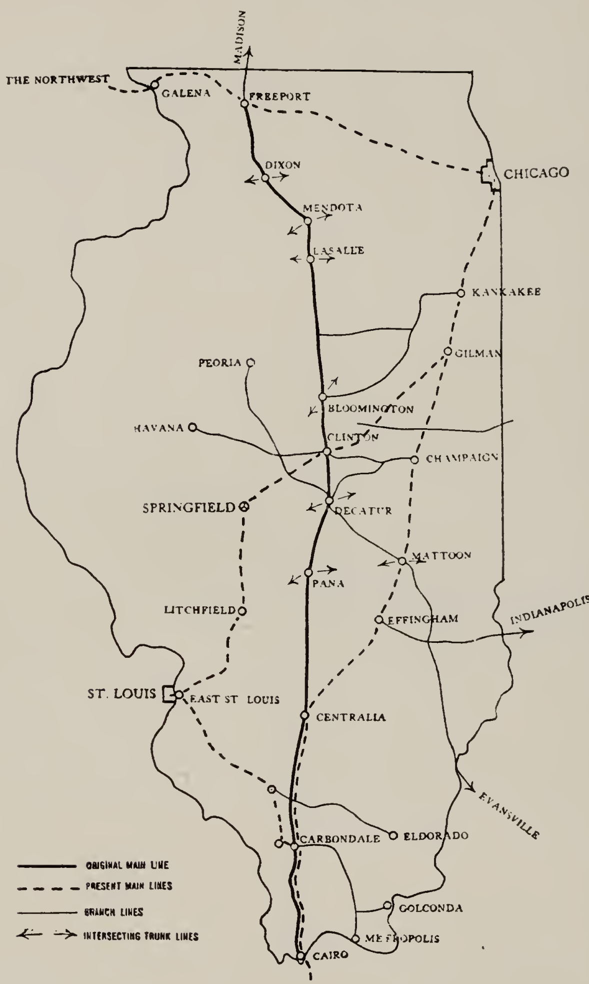


FIG. 68.—Map showing the Illinois Central system in Illinois.

been incorporated into the line from Chicago to the Gulf. The main line west from Chicago utilizes that part of the original trunk line lying between Freeport and Galena. The St. Louis-Cairo line joins the old main line at Carbondale. From Freeport to Centralia, including that part lying in La Salle County, the former main line is merely a feeder for the present trunk lines of the Illinois Central. Considerable freight is carried on it, but only local passenger service is maintained. The original Illinois Central Railroad was built without reference either to the direction which trade then took, or to the future likelihood of trade. There was no particular need for a road north and south through the middle of the State; the road bisected the State with mathematical neatness, but it rested on no adequate geographic basis, and lacking geographic justification it had to build additional lines which followed commercial opportunities and not geometrical plans.

### CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD

This road follows the Illinois River to the ''Great Bend'' and then strikes west across the prairies by way of the valley of Bureau Creek. It was the first road built in this region, and has been of greater importance in the development of the upper valley than any other. The road was chartered in 1850 as the Rock Island and La Salle Railroad, to be built between the two cities named. Shortly afterward, a continuation was authorized to parallel the Illinois and Michigan Canal, ''thus making a continuous line of railway from the city of Chicago to the head of navigation on the Illinois; thence to the city of Rock Island at the foot of the upper rapids of the Mississippi, now generally known as the only feasible point where that stream can be bridged from its mouth to the falls of St. Anthony.''[108] The construction of the road was pushed vigorously, and it was opened in January, 1853, to Morris; in February to Ottawa; and a month later to La Salle. The passenger rate of four cents per mile charged by the packet boats was cut by the railroad, and the time of transportation was reduced to one-fifth of that formerly required. It was the competition of the Rock Island Railroad, more than that of any other, which caused the ruin of the Illinois and Michigan Canal, and this road has continued to carry most of the commerce of the upper valley to the present day.

### CHICAGO, BURLINGTON AND QUINCY RAILROAD

The Burlington is another road which was built west from Chicago in the early fifties and which helped to make Chicago the great gateway to the interior. It was built far enough to the north of the Illinois to avoid bridging the deep lower tributaries of that river. It is essentially a prairie road. Service to Mendota was begun in 1854.

From 1850 on there was considerable agitation in La Salle County for a railroad which would develop the water powers of Fox Valley. In 1852 the Ottawa, Oswego, and Fox River Valley Railroad was chartered, but no work was done. In 1866 the company was reorganized, and in 1871 the

[108]President's Report, December, 1851, in History of La Salle County, p. 424, 1886.

road was completed from Sheridan to Streator. Along this new railroad a number of villages sprang up, such as Sheridan and Grand Ridge, which are trading centers for limited farming districts. The road is now the Fox River branch of the Chicago, Burlington and Quincy Railroad.

## OTHER RAILROADS

In 1885 a branch of the Chicago and North Western Railroad was built to Spring Creek. The North Western has many lines extending through Wisconsin, upper Michigan, Minnesota, and the northwest, regions of great resources, but generally lacking in coal. The coal mines of Bureau and La Salle counties are the northernmost producers in Illinois and therefore conveniently situated to much of the territory traversed by the North Western Railroad. It was to secure coal especially for its Wisconsin and Minnesota territory that the North Western laid this branch to Spring Creek and there built the coal-mining city of Spring Valley. In 1912 this road shipped out of Bureau County 974,920 tons of coal.[109].

In 1905 the Chicago, Milwaukee and St. Paul Railroad, with a network of roads in a territory similarly deficient in coal, also built a line southward into Bureau and La Salle counties. In 1906 the shaft at Cherry was opened, and in 1907 it extended its road from Granville to Oglesby, crossing the river on the tracks of the C. I. & S. R. R. The St. Paul Railroad thus opened a new mining district in La Salle County south of the river, and also secured access to the Portland cement district at Oglesby. This railroad is the heaviest carrier of coal in the region, having shipped 1,427,786 tons in 1912.[110].

The other railroads within the region are Elgin, Joliet, and Eastern Railroad, an outer belt freight line for Chicago, which crosses the Illinois near its head, and penetrates the coal district of southern Grundy County. This road was built into this section chiefly to gain access to the Coal City mining region, and ranked third in 1912 in its shipments of coal, with a tonnage of 420,961 from Grundy County.[111]

Kankakee and Seneca Railroad built without apparent justification, transfers some freight from the Rock Island Railroad to New York Central Lines; La Salle and Bureau County Railroad is a short freight road which connects the smelters at La Salle with the Burlington and North Western roads; Chicago, Indiana and Southern Railroad was built west into the mining and manufacturing section of Bureau County and taps a long line of railroads west and south of Chicago for the eastern traffic of the New

[109]Illinois Coal Report, 1912, p. 78.

[110]Idem, p. 78.

[111]Idem, p. 80.

York Central Lines; Depue and Northern Railroad is an unimportant line for the transfer of smelter freight.

### PERIODS OF CONSTRUCTION

The greatest period of railroad building in this State was the decade 1850 to 1860. In 1851 there were in operation 116 miles of railroad in Illinois; in 1855 there were 887; in 1860 there were 2,790; in 1865 there were 3,157; and in 1868 there were 3,440 miles. In the upper Illinois Valley more railroads were built between 1852 than at any other time. After 1853 the great prairies were speedily cut into strips by road after road that crosses the unsettled parts of the State. Locally, a second period of active construction occurred between 1900 and 1910 when the mining and manufacturing interests of eastern Bureau and western La Salle counties attracted a number of roads.

### INFLUENCE OF RAILROADS ON DEVELOPMENT

The nearly level surface of much of Illinois has favored the construction of railroads and has helped greatly to give the State first rank in railroad mileage. The railroad, operating throughout the year and providing rapid and cheap transportation, has solved the transportation problem of the interior, and permitted the development of regions inaccessible by water routes. The services of the railroad to this region may be summarized under three heads:

1. It made practicable the settlement of the large prairies of northern Illinois. The resources of the prairie were known long before railroads were built across them, but the lack of timber and transportation facilities had prevented their settlement. In La Salle County the central townships, situated near the river and canal were well settled by 1845, whereas the northern and southern tiers of townships, remote from these waterways, were still largely vacant in 1850. Of the two southern townships, Groveland and Osage, it is related that La Salle County took them because Marshall and Livingston counties were unwilling to do so, and that in 1855 Groveland Township "was unbroken prairie, without an inhabitant."[112] In 1850 the prairies of Bureau County were still largely vacant, the settlements being near belts of timber. By 1854 (after two railroads had crossed it), all the land in the county was taken up.[113] The growth of the population throughout this region during the decade 1850 to 1860 is shown by Table 6. Nearly all the prairie region north of Illinois River was settled in this decade, due largely to the railroads. The railroads provided (a) markets for farm produce, (b) lumber for buildings and fences, and (c)

[112]Baldwin, E., History of La Salle County, p. 468, 1877.

[113]Matson, Nehemiah, Voters and tax-payers of Bureau County.

coal for fuel. As a result, the prairie region began to set the pace for the country in agricultural production.[114]

2. The opening up of millions of acres of virgin soil of great fertility attracted many immigrants to the State. Many native Americans still came from the eastern states, lured by the advertisements of the real estate offices of the railroads. In this period also, a great stream of European emigration began to pour into our country, and many of these people settled on the prairies. Over-population pressed hard at that time upon the poorer classes of various European lands, political troubles were widespread, and labor difficulties and crop failures crowded out many tradesmen, laborers, and farmers. These people were from northern Europe—German, English, Irish, French, Dutch, Scandinavian, and Flemish. Most of the Irish became laborers, but the majority of the other races turned to farming, continuing the life to which they had been brought up in their native land. When these immigrants came, the good lands of the East had been occupied, and they were forced to turn westward to secure cheap lands. Immigration continued until in many places the foreign outnumbered the native settlers. In 1900 one-half to three-fourths of the total population of La Salle and Bureau counties were born of foreign parents, largely the descendants of these agricultural immigrants who came after the middle of the last century. In 1870 the following proportions held in a number of townships in Bureau County:[115]

| | Native-born | Foreign-born |
|---|---|---|
| Hall Township | 744 | 315 |
| Westfield Township | 418 | 978 |
| Clarion Township | 267 | 756 |
| Selby Township | 388 | 1109 |
| La Moille Township | 197 | 36 |
| Berlin Township | 189 | 42 |

Most of the foreigners who came at this time were Germans. Somewhat later many Scandinavians came to Grundy and La Salle counties. These people have all been assimilated long since and have formed a valuable addition to the blood and wealth of the region.

3. The railroads have facilitated the development of the mineral resources of the region and stimulated the growth of its industries, as sketched in the next section.

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[114]Baldwin, E., History of La Salle County, p. 210, 1877: "The cheap transportation of lumber has enabled the settlers to build and fence away from the timber, and independent of the groves so eagerly sought for in the early settlements. The prairie towns on the outskirts of the county have rapidly settled, and experience has proved that there is no valid objection to the settlement of the largest prairies when lumber can be obtained for building and fencing, and coal for fuel."

[115]Summarized from Voters and tax-payers of Bureau County, p. 172, 1876.

## Mining and Manufacturing

Industries[116] have developed in this region chiefly because it is provided with two sources of mechanical energy—water power and coal. The earliest industries depended on water power, the later industrial expansion has been due chiefly to the use of coal. After the rich soils of the region, coal probably has been the most important factor in its growth of population.

### COAL MINING

The development of coal mining in the upper valley has been affected by a number of conditions: (1) The occurrence of the coal beds is related to the La Salle anticline. Upon the crest of the anticline coal is wanting. (a) East of the anticline is the coal-mining district of southern Grundy County, including the numerous mines in Braceville, Felix, and Greenfield townships. From Morris westward the coal beds become fewer and poorer as they rise on the anticline. At Morris, coal is reached in shallow shafts, at Marseilles in drifts driven into the sides of the valley, and at Ottawa much weathered coal lies exposed at the surface in the valley. With the exception of eastern Grundy County the coal east of the anticline is found only in thin beds and has little commercial value. (b) West of the anticline the "Coal Measures" are carried underground rapidly by the steep dip of the western flank of the fold. They are much thicker than east of the anticline, and the number of coal beds is greater. West of the Vermilion rivers from four to five coal seams are encountered in all deep borings. The second bed above the base of the series (the so-called Third Vein coal) is worked most extensively and averages three feet thick. One hundred and forty feet on the average above it lies Coal No. 5 (Second Vein), and 40 feet higher is bed No. 7 (First Vein); both of these have a thickness about equal to that of the Third Vein, and have been mined to some extent. The coal beds lie much deeper west of the fold than they do east of it, and are reached by shafts three to four hundred feet deep. (2) The coal is unusually good for the central region. The Third Vein coal is a high-grade block coal, and brings top prices for steaming purposes. (3) The location of this area at the northern end of the Illinois coal basin has favored its exploitation, (a) because it makes mining possible at lesser depths than farther south toward the center of the basin, and (b) the coal is in an advantageous position to supply the regions farther north (4) The excellent transportation facilities, and especially the low rates east and west along the river and canal, have favored its shipment to relatively distant points. The markets to which the coal is shipped are (a) the northern region, (b) the prairie region to the west, and (c) the great market in nearby Chicago.

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[116]Statistics, unless otherwise acknowledged, are from the 13th Census.

Coal was first used by the Indian and the French adventurer. Marquette and Joliet noted in 1673 the occurrence of coal along the valley. Joutel in his journal of 1687 described coal exposed on the slopes of Illinois Valley. Later, the pioneer farmer found a valuable resource in the mineral fuel which he dug out of the valley sides. The earliest coal mining consisted merely in working outcropping banks; this was done along the western flank of the anticline near Split Rock and on the Big Vermilion, especially at Lowell. About Ottawa surface coal was dug for years in sufficient amount to supply local demands. In 1853 a boring was made at La Salle on the bottoms south of the canal, and in 1855 the first shaft was put into commission.[117] With this date begins the commercial exploitation of the coal resources of the region. The upper Illinois Valley district is producing at present an aggregate of five million tons of coal annually. The quantity of coal mined from 1881 to 1907 is as follows: La Salle County, 38,493,630 tons; Bureau County, 25,011,119 tons; Grundy County, 27,112,051 tons. In 1912 Bureau County produced 1,681,103 tons from 13 mines; La Salle, 1,605,482 from 36 mines; Grundy, 756,388 from 13 mines; and the two new mines of Putnam County, 716,531 tons.[118]

The growth of the cities and villages of southeastern Grundy and southwestern Will counties has been due almost entirely to the development of coal mining. The mines along the C. & A. R. R. had developed into coal-mining towns of some importance by 1880. In the decade 1880 to 1890 Braceville increased more than eight-fold in population and attained second rank in the county. In that decade mines on the Santa Fe Railroad also were developed. In 1880 there was no Coal City; in 1890 it had 1,672 inhabitants, and in the next twenty years another thousand were added. Since 1890 numerous other shafts have been sunk in Grundy County, and villages have sprung up with great rapidity. South Wilmington grew to a village of 2,500, Carbon Hill secured 1,200 inhabitants in less than ten years, and Eileen and East Brooklyn have sprung up in the last decade. With the exception of Coal City, the older coal-mining towns have lost part of their population as their mines have become less productive. Braceville has less than half of its population of 1890; Central City, Diamond, Godley, Carbon Hill, and Gardener all have lost steadily in the last decade. The prosperity of such towns is brief; they are called into existence by coal mining, commonly develop no other permanent interests, and as the mines are worked out the miners gradually move away and the towns decay.

In La Salle County coal mining has not created new towns so much as it has stimulated the growth of places already established. The earliest coal mining of importance in the upper valley was at La Salle and Peru, and the steady growth of these cities has been based on the use of their coal for

[117]Kett, Past and present of La Salle County, p. 301.

[118]Illinois Coal Report, 1912, pp. 68-69. In this year there were 12 mines producing in excess of 150,000 tons each.

power in a variety of industries. Later came the development of Streator, the greatest coal-mining city in the region. In 1870, Streator was barely in existence; by 1890 it was the largest city in the county, with 11,414 inhabitants. It holds this place still, but appears to have developed its mines about to full capacity. Kangley is a mining town near Streator, which has lost two-thirds of its population in the last decade. In 1907 the St. Paul Railroad was built from Granville to Portland, and a shaft sunk near Cedar Creek. About this shaft has grown the village of Cedar Point with a population of 500 in its second year. This settlement illustrates the latest development in the upper valley—coal mining in the prairies. Vast dump heaps are being reared here and there on the prairie, where a few years ago lay plowed fields.

In Bureau County, Hall Township includes the majority of the coal mines. In 1883 this township had a population of 1,058; in 1884 the first shaft was sunk at Spring Valley; the next year shaft No. 3 was put in operation, and the tracks of the North Western Railroad were completed. Somewhat later a shaft was sunk at Seatonville, and in 1890 another at Ladd; in this year the population of the township was 5,683. In 1900 Spring Valley had 6,214 inhabitants, and Ladd 1,324. In 1899 the shaft at Dalzell was opened, and at the same time coal mining was begun at Marquette. In 1910 the township had a population of 12,493, or twelve times its population of 1880. This growth is due entirely to coal mining; outside of the mining towns the population has decreased gradually. Cherry village, in Arlington Township, was settled in 1905 and still had a population of more than a thousand after the great disaster. In Putnam County, Granville Township shows a similar growth. Granville was a village of about three hundred inhabitants in 1904, when the first shaft was sunk. In five years it added more than a thousand people, and close at hand the villages of Mark and Standard duplicated its growth.

## MANUFACTURING

### DEVELOPMENT

The growth of industries in the region is due chiefly to (1) its raw materials, (2) the increase of population which created local markets for certain manufacturers and provided labor, (3) the construction of railroads, which made more distant markets accessible, and (4) the development of coal mining, which provided a cheap and efficient source of power. The growth of population in the upper Illinois Valley during the last four decades has been virtually confined to a growth of the population engaged in mining and manufacturing. The manufactures may be grouped in three classes: (1) Manufactures dependent on geographic advantages, such as raw materials, or power, or both. To this class belong the most important industries of the region: zinc smelting and refining, the manufacture of agricultural implements, glass, paper, cement, and fire brick. These articles are produced chiefly for markets outside the region. (2) Industries developed through highly specialized skilled labor. These depend on persistent individual initiative, not on local advantages. Among such industries are the manufacture of clocks and musical instruments. (3) Certain industries developed to supply local demands. Such are the brewing of malted liquors, cigar making, and printing and publishing. These also are not based on any particular geographic advantage, but are an expression of the density of population.

In the history of industry in the upper Illinois Valley water power played the leading role at first; the later development is due to the use of coal. The first industries of the region were carried on along Fox River. The newspapers of the early fifties viewed the Fox Valley "with a prophetic eye," as the busy center of manufactures in this section. Dayton, on the lower Fox River, secured several mills before sites had been laid out for most of the present cities of the region. In 1834 it had a flour mill, a saw mill, tannery, and numerous other establishments.[119] In 1842 the Pioneer Woolen Mills were built at Dayton, and are said to have introduced the power loom to this State.[120] This plant was enlarged considerably in 1864. In 1876 a paper mill was added, with a daily output of two tons.[121] Since then the dam has been destroyed, and all that remains of Dayton and its industries is the walls of the ruined mills, and a few houses.

Coal was used for local manufactures after the first shaft was sunk at La Salle in 1855. In 1858 a zinc smelter and refinery was built at La Salle, and this industry marks the beginning of permanent industries in the region. In 1880 the value of manufactures in the three counties of the upper valley was $6,677,856, distributed as follows: La Salle County, $5,647,142; Bureau County, $560,708; Grundy County, $470,006. During the next decade their value increased 34 per cent, the total for La Salle County being $7,821,617; for Bureau County, $703,847; and for Grundy County, $447,568. In this decade the number of employes in the manufacturing industries of the three counties increased from 3,910 to 6,285.[122] In 1909 the industries of La Salle and Streator alone were almost equal to the industries of La Salle County in 1890.

### DISTRIBUTION OF INDUSTRIES

The western half of the upper valley has become of increasing importance in manufacturing, because of its superior supply of coal. La Salle, Peru, Streator, Portland, and Depue all are dependent largely on manu-

[119] Baldwin, E., History of La Salle County, p. 266, 1877.

[120] Keyes, Directory of La Salle County, Introduction.

[121] Kett, Past and present of La Salle County, p. 334.

[122] Tenth Census, vol. 2, and Eleventh Census, Report on manufacturing industries, Part 1.

facturing industries. In the eastern half of the region, on the other hand, agricultural interests always have predominated, and only Ottawa and Marseilles have extensive manufactures. A short summary of the leading industries of the various cities is given below:

1. The two principal industries of *Morris* are the tanning of leather and the manufacture of hardware. They give employment to about 400 people. The tannery was established in 1850, and has been built up by the development of a local supply of skilled labor.

2. *Marseilles* is the only city in the region which now employs water power. It was built about the rapids of the Illinois, and coal is used only in flood times and for auxiliary purposes, as in the drying of paper. The industries of Marseilles date back to 1868, when a masonry dam was built across the Illinois. A paper mill was established in the same year, and three others have been added since, giving employment to about 500 men. In 1868 the manufacture of agricultural machinery also was begun, and by 1910 had grown to be a business employing more than 250 men. The manufacture of agricultural machinery was developed because of (a) local control of a number of inventions, (b) the central location of the city in a great farming district, and (c) cheap water power. Marseilles always has derived almost its entire support from its industries. The city has only a small foreign-born population and depends on native artisans almost entirely.

3. *Ottawa* in 1909 was the twenty-sixth city in the State in the value of its manufactures. Until 1875 it used water power chiefly for its industries. In 1858 "expensive and cumbrous agricultural implements, such especially as reapers and wagons" were manufactured.[123] At that time also a large starch factory for making table and laundry starch was in operation, utilizing some of the corn produced so abundantly in this region. By 1872 flour, cutlery, and plate glass had become important products. In 1877 glass and agricultural implements (corn cultivators and corn shellers) were of about equal value.[124] In 1880 glass was the most valuable product of the city, other leading products being agricultural implements, wagons, starch, and flour.[125] When the natural gas fields in Indiana were opened, the glass industry was moved away from Ottawa to this new region of cheap and superior fuel. A few years ago the plate glass industry was established at Ottawa, and is developing rapidly. The leading manufactures of Ottawa in 1909 were glass, pottery, fire-clay products, agricultural implements, carriages, and pianos with a total value of $2,467,985. The manufacture of glass and brick and tile depends on the local supply of glass sand of the St. Peter formation, and the fire clays of the lower "Coal

[123]La Salle County, Directory, p. 28, 1858.

[124]Baldwin, E., History of La Salle County, p. 543, 1877.

[125]Tenth Census, vol. 2.

Measures." The St. Peter sand is quarried at numerous points, especially between Ottawa and Utica in Illinois Valley, and about Wedron on Fox River. Much sand is mined cheaply about Ottawa by hydraulic methods. Most of the sand now mined at Streator and Alton is shipped to factories in Indiana. The glass-sand industry has become important locally because (a) the St. Peter sandstone is soft, of even texture, and may be worked with great ease, in many places wick pick and shovel; (b) the sand is of the highest quality for the manufacture of glass, being almost pure silica and free from "loam;" (c) with one exception this is the only commercial outcrop of this sandstone in Illinois; and (d) the sandstone occurs in bluffs along the railroad lines that follow the Illinois and Fox valleys and is loaded directly from the pits into the cars. The decline of the glass industry at Ottawa has been due solely to the difficulty of securing good fuel. There are several fire brick, tile, terra cotta, and pottery establishments at Ottawa, which work clays on the valley terrace. The clay is refractory (can withstand a high degree of heat without melting), is plastic, and can be worked very cheaply. The coal which is associated with the clay furnishes most of the fuel for its firing.

4. *Utica* began the manufacture of hydraulic cement while the canal was being built. The cement is made from certain clayey beds of the Lower Magnesian limestone. In 1872 the cement mill employed 300 men, and had a capacity of 150,000 barrels annually.[126] In 1877, 75,000 barrels were made, valued at $110,000,[127] and in 1880, the output was valued at $93,000.[128] Since that time the output has decreased steadily and rapidly, as Portland cement has come into successful competition with the older article. Fire clay is worked about Utica for the manufacture of drain tile, sewer pipe, and fire brick.

5. *La Salle* and *Peru* form one industrial center, divided only by arbitrary corporate limits. Since 1858 the smelting and refining of zinc has been the dominant industry of the twin cities. In 1877 there were four plants in operation, with an output of 900,000 tons of spelter (zinc) annually, valued at about $1,100,000.[129] In 1880, about 850 people were employed in the smelting and and refining of zinc, and the value of the output was $1,772,000.[130] The entire industrial output of La Salle in 1909 was worth $5,307,551, and consisted largely of zinc and Portland cement, although its clocks have a national reputation. Figures are not available for Peru; its industries are also very extensive, but somewhat more diversified, the leading products being zinc, plows, and malted liquors.

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[126]Keyes, Directory of La Salle County, p. 275.

[127]Kett, Past and present of La Salle County, p. 333.

[128]Tenth Census, vol. 2.

[129]Baldwin, E., History of La Salle County, pp. 542-3, 1877.

[130]Tenth Census, vol. 2.

The zinc industry was established in these cities because of several influences: (a) The upper Illinois Valley is the first place where zinc ore, traveling from the mines of southwestern Wisconsin to the eastern markets, meets coal. In smelting zinc, the amount of fuel required is greater than the amount of ore, so that it is cheaper to ship the ore to the fuel than fuel to ore. The coal fields of this region also are located conveniently for ore shipped east from the Rocky Mountain district. (b) Good transportation is afforded by several railroads. The La Salle and Bureau County Railroad was built recently to the Chicago, Burlington and Quincy and the Chicago and North Western railroads, giving the La Salle smelters the choice of four routes. (c) Western La Salle County, largely because of coal mining, has become a labor market of almost metropolitan character.

6. *Portland* developed from the insignificant hamlet of Oglesby within the last ten years, and according to the census of 1910 had a population of 3,194. From Bailey's Falls to the mouth of Vermilion River the La Salle limestone is exposed at the surface. Directly beneath it lie soft Carboniferous clays, and still lower is a seam of excellent coal. These three mineral resources have located here a large Portland cement industry. Portland cement is made from limestone and clay, which are ground, mixed in certain proportions, and fired. In this industry as in smelting zinc, much more fuel is required than rock and clay. All these materials are bulky, so that the industry can be carried on profitably only where limestone, clay, and coal are associated intimately. Conditions scarcely could have been better for the establishment of such an industry than they are on lower Vermilion River. Near the river the La Salle limestone underlies a thin cover of earth which can be stripped off with ease. The limestone has an average thickness of 24 feet and is underlain by 16 feet of clay. The coal is mined by a shaft adjoining the mills. The marvelous development of this industry has built the city of Portland and stimulated the growth of Peru and La Salle, for the most of the men employed in the cement mills live in the latter cities. Since 1907 Portland has been able to ship by three railroads.

7. *Depue* during the last five years has been transformed from a decaying river village into a thriving manufacturing town. A large zinc smelter was established here recently, which has the same advantages enjoyed at La Salle and Peru. In 1900 Depue had a population of 488; in 1910, of 1,339.

## Rural Conditions

Whereas the mining and manufacturing interests have developed rapidly during the last thirty years, the agricultural output of the upper valley has increased much more slowly. At the beginning of this period most of the arable land was in cultivation, so that the farm area has grown but slightly. If methods of cultivation have improved gradually, they have barely offset the injury done the soil by the long continued cultivation of a few crops. The output of the farms of the region has varied but little in the last forty years. The value of the crops, however, has risen steadily during this period, largely because of the increasing needs of our rapidly growing urban population. Better prices have brought prosperity and ease to the farmer, and also a tremendous increase of farm values.

TABLE 3.—*Value of farm property*

| | Bureau | Grundy | La Salle |
|---|---|---|---|
| 1860 | $ 8,900,159 | $ 2,673,181 | $ 7,979,789 |
| 1870 | 18,982,291 | 8,005,098 | 26,179,442 |
| 1880 | 24,343,725 | 8,772,875 | 30,893,423 |
| 1890 | 24,222,290 | 10,541,380 | 36,706,880 |
| 1900 | 37,970,986 | 18,141,875 | 58,020,553 |
| 1910 | 76,034,035 | 37,808,965 | 114,911,820 |

TABLE 4.—*Value of farm crops*

| | Bureau | Grundy | La Salle |
|---|---|---|---|
| 1870 | $3,936,439 | $1,043,965 | $ 5,502,502 |
| 1880 | 3,978,672 | 1,604,366 | 5,223,503 |
| 1890 | 3,389,410 | 1,305,720 | 5,075,930 |
| 1900 | 4,799,181 | 2,394,580 | 7,201,557 |
| 1910 | 7,165,497 | 3,774,509 | 10,222,235 |

Farming in this region is little diversified, and the tendency in recent years has been to still less diversification. Wheat, which was grown formerly in considerable quantity, is now produced scarcely at all (fig. 69); less than 15,000 bushels were grown in the upper Illinois counties in 1900. The great staple throughout this section always has been corn, and in general other crops are grown only for rotation purposes. Oats, especially, are grown in rotation with the corn, and constitute the second crop of the region. Hay is the third crop, but its production gradually is falling off as land values increase. The only other important product of the farm is live stock. Since the development of Chicago as a meat-packing center, the raising of corn-fed cattle has become an important item on most farms. Many western range cattle are shipped in, fattened, and then sold in Chicago.

TABLE 5.—*Farm values of live stock*

| | Bureau | Grundy | La Salle |
|---|---|---|---|
| 1860 | $1,294,258 | $ 453,082 | $ 1,224,526 |
| 1870 | 3,150,413 | 1,113,149 | 3,906,367 |
| 1890 | 3,686,500 | 1,273,640 | 4,627,320 |
| 1900 | 3,790,902 | 1,355,945 | 4,279,015 |
| 1910 | 5,961,441 | 2,394,943 | 6,635,026 |

Dairying is carried on chiefly to supply local needs. In 1900 the value of the dairy products was slightly over one million dollars. In 1909 the dairy products of the three counties were valued at $2,019,000.

The stability of rural conditions is strikingly shown by Table 6. The rural population of this region has grown but slightly in the last fifty years. In 1860 the agricultural population was about as dense as now, and from 1870 to 1880 the rural sections were settled even more densely than at present. The improvement of labor-saving farm machinery has more than kept pace with the increase of farm area since 1860. New forms of labor-

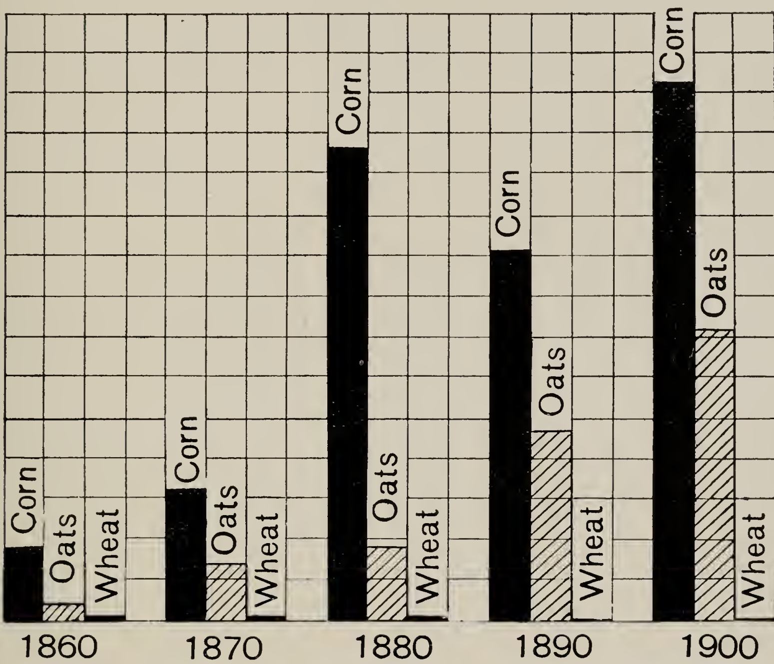


FIG. 69.—Graph showing grain produced in La Salle, Bureau, and Grundy counties.

saving machinery were introduced frequently, and from decade to decade fewer people were required to take care of the land. In the last twenty years the rural population has decreased noticeably. Whatever growth of population has taken place in the upper valley since 1875 has been due to its industrial development; the towns alone have offset the losses of the agricultural districts. The population of La Salle County increased by 9,611 in the decade 1870 to 1880. During this time Streator, La Salle, Marseilles, Peru, and Mendota gained 9,020, whereas 19 of the 37 townships of the county lost in population. From 1880 to 1890 the county gained 10,395; seven towns and villages contributed an increase of 13,048, which

TABLE 6.—*Population in upper Illinois Valley by decades from 1850 to 1910*

| Area | 1850 | 1860 | 1870 | 1880 | 1890 | 1900 | 1910 |
|---|---|---|---|---|---|---|---|
| **La Salle County** | 17,815 | 48,332 | 60,792 | 70,403 | 80,798 | 87,776 | 90,132 |
| Adams Township including Leland village | 547 | 1,286 | 1,662 | 1,612 | 1,328 | 1,453 | 1,278 |
| Leland | .... | .... | .... | 653 | 554 | 634 | 545 |
| Allen Township including Ransom village | .... | 391 | 877 | 1,016 | 1,052 | 922 | 956 |
| Ransom | .... | .... | .... | 132 | 338 | 339 | 370 |
| Brookfield Township | 252 | 872 | 1,230 | 1,087 | 881 | 825 | 812 |
| Bruce Township | 378 | [a]1,238 | 1,921 | 6,508 | 12,261 | 14,529 | 14,486 |
| Total for Streator in Bruce and Eagle townships | .... | .... | 1,486 | 5,157 | 11,414 | 14,079 | 14,253 |
| Dayton Township | 630 | [b]1,188 | 653 | 711 | 761 | 800 | 644 |
| Dayton | 168 | .... | 163 | 221 | 232 | .... | .... |
| Wedron | .... | .... | .... | 40 | 117 | .... | .... |
| Deer Park Township | 294 | 1,031 | 894 | 850 | 802 | 851 | 827 |
| Dimmick Township | 378 | 1,081 | 1,222 | 1,012 | 851 | 814 | 750 |
| Eagle Township including Kangley village and part of Streator city | 336 | [c]1,218 | 870 | 1,205 | 2,368 | 2,478 | 1,715 |
| Kangley | .... | .... | .... | .... | 934 | 1,004 | 380 |
| Earl Township including Earlville city | 819 | 1,702 | 2,129 | 2,034 | 2,020 | 1,957 | 1,816 |
| Earlville | .... | .... | .... | 963 | 1,058 | 1,122 | 1,059 |
| Eden Township including Cedar Point and Tonica villages | 504 | 1,435 | 1,523 | 1,524 | 1,410 | 1,382 | 1,817 |
| Cedar Point | .... | .... | .... | .... | .... | .... | 545 |
| Tonica | .... | .... | .... | 504 | 473 | 497 | 483 |
| Fall River Township | .... | d | 523 | 553 | 395 | 406 | 416 |
| Farm Ridge Township including Grand Ridge village | 378 | 1,021 | 1,042 | 1,128 | 1,110 | 1,119 | 1,068 |
| Grand Ridge | .... | .... | .... | 135 | 328 | 392 | 403 |
| Freedom Township | 908 | 1,301 | 1,262 | 1,163 | 1,025 | 1,039 | 915 |
| Grand Rapids Township | 336 | [d]1,426 | 1,148 | 1,034 | 798 | 639 | 673 |
| Groveland Township including Dana and Rutland villages | .... | 608 | 1,561 | 1,588 | 1,601 | 1,986 | 1,622 |
| Dana | .... | .... | .... | 150 | 221 | 310 | 254 |
| Rutland | .... | .... | .... | 402 | 509 | 893 | 754 |

[a]Bruce Township was divided into Bruce and Otter Creek townships in 1868.
[b]Dayton Township was divided into Dayton and Wallace townships in 1867.
[c]Eagle Township was divided into Eagle and Richland townships in 1868.
[d]Grand Rapids Township was divided into Grand Rapids and Fall River townships in 1862.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hope Township including Lostant village | 376 | 1.022 | 1,437 | 1,235 | 1,054 | 1,351 | 1,174 |
| Lostant | .... | .... | .... | 363 | 378 | 480 | 458 |
| La Salle Township including La Salle and Portland cities | [e]2,911 | 4,836 | 5,452 | 8,987 | 11,620 | 13,361 | 17,239 |
| La Salle | .... | 4,016 | 5,200 | 7,847 | 9,855 | 10,446 | 11,537 |
| Portland | .... | .... | .... | .... | .... | .... | 3,194 |
| Manlius Township including Crotty village and part of Marseilles city | 630 | 1,608 | 2,463 | 2,114 | 2,683 | 2,771 | 3,090 |
| Crotty | .... | .... | 691 | 738 | 1,190 | 1,036 | 1,005 |
| Total for Marseilles city in Manlius and Rutland townships | .... | .... | 758 | 1,882 | 2,210 | 2,559 | 3,291 |
| Mendota Township including part of Mendota city | [f]378 | 2,695 | 4,589 | 4,573 | 4,285 | 4,438 | 4,510 |
| Total for Mendota city in Mendota and Troy Grove townships | .... | 1,930 | 3,546 | 4,142 | 3,542 | 3,736 | 3,806 |
| Meriden Township | [f]378 | 738 | 1,069 | 991 | 797 | 745 | 647 |
| Miller Township | .... | .... | .... | 1,171 | 1,016 | 880 | 794 |
| Mission Township including Sheridan village and part of Millington village | 840 | 1,601 | 1,596 | 1,517 | 1,394 | 1,384 | 1,350 |
| Millington (part of) | .... | .... | .... | .... | 89 | 96 | 81 |
| Sheridan | .... | .... | .... | 442 | 425 | 485 | 506 |
| Northville Township | 951 | 1,270 | 1,187 | 1,061 | 857 | 799 | 768 |
| Ophir Township | 210 | 1,229 | 1,085 | 979 | 843 | 911 | 898 |
| Osage Township including East Wenona village | .... | 675 | 1,170 | 1,104 | 1,036 | 1,062 | 1,088 |
| East Wenona | .... | .... | .... | .... | .... | .... | 367 |
| Ottawa Township including part of Ottawa city | [g]3,219 | 6,522 | 8,199 | 7,598 | 9,464 | 9,693 | 8,620 |
| Total for Ottawa in Ottawa and South Ottawa townships | .... | .... | 7,736 | 7,834 | 9,985 | 10,588 | 9,535 |
| Otter Creek Township | .... | a | 1,009 | 925 | 1,085 | 1,143 | 1,167 |
| Peru Township including Peru city | [e]2,911 | 3,466 | 3,945 | 5,053 | 5,883 | 7,256 | 8,390 |
| Peru | .... | 3,132 | 3,650 | 4,632 | 5,550 | 6,863 | 7,984 |
| Richland Township including Lenore village | .... | c | 730 | 778 | 712 | 844 | 835 |
| Lenore | .... | .... | .... | .... | .... | .... | 203 |
| Rutland Township including part of Marseilles city | 630 | 1,029 | 1,499 | 1,767 | 1,779 | 1,909 | 2,308 |
| Serena Township | 370 | 960 | 1,076 | 1,077 | 919 | 964 | 947 |
| South Ottawa Township including part of Ottawa city | .... | 1,026 | 597 | 1,289 | 1,729 | 2,254 | 2,178 |
| Troy Grove Township including Troy Grove village and part of Mendota city | 662 | 1,262 | 1,501 | 1,407 | 1,313 | 1,263 | 1,078 |
| Troy Grove | .... | .... | .... | 168 | 283 | 316 | 289 |

[e]Salisbury Township including La Salle and Peru townships.
[f]Meriden Township including Mendota and Meridian townships.
[g]Included South Ottawa Township.

TABLE 6.—*Population in upper Illinois Valley by decades from 1850 to 1910*—Continued

| Area | 1850 | 1860 | 1870 | 1880 | 1890 | 1900 | 1910 |
|---|---|---|---|---|---|---|---|
| Utica Township including North Utica village | 252 | 992 | 1,145 | 1,273 | 1,568 | 1,582 | 1,342 |
| North Utica | .... | .... | .... | 767 | 1,094 | 1,150 | 976 |
| Vermilion Township | 458 | 604 | 671 | 612 | 556 | 550 | 507 |
| Wallace Township | .... | b | 734 | 800 | 644 | 656 | 568 |
| Waltham Township | 168 | 967 | 1,115 | 1,067 | 898 | 760 | 839 |
| **Bureau County** | **8,841** | **26,426** | **32,415** | **33,172** | **35,014** | **41,112** | **43,975** |
| Arispie Township including part of Tiskilwa village | .... | 811 | 1,216 | 1,160 | 1,043 | 1,209 | 1,094 |
| Total for Tiskilwa in Arispie and Indian townships | .... | 559 | 761 | 753 | 801 | 965 | 857 |
| Berlin Township including Malden village and part of Dover village | 439 | 1,211 | 1,469 | 1,276 | 1,126 | 1,052 | 1,009 |
| Total for Dover in Berlin and Dover townships | 103 | 362 | 304 | 239 | 220 | 247 | 181 |
| Malden | .... | .... | .... | 359 | 319 | 309 | 255 |
| Bureau Township | 167 | 936 | 1,145 | 947 | 779 | 761 | 735 |
| Clarion Township | 537 | 1,053 | 1,023 | 851 | 792 | 705 | 611 |
| Concord Township including Buda and Sheffield villages | 364 | 982 | 2,309 | 2,636 | 2,759 | 2,965 | 2,554 |
| Buda | .... | .... | .... | 778 | 990 | 873 | 887 |
| Sheffield | .... | 706 | 771 | 905 | 993 | 1,265 | 1,009 |
| Dover Township including part of Dover village | 742 | 960 | 1,402 | 1,341 | 1,188 | 1,076 | 896 |
| Fairfield Township | 205 | 520 | 748 | 915 | 847 | 921 | 797 |
| Gold Township | 19 | 245 | 392 | 616 | 499 | 766 | 646 |
| Greenville Township | 244 | 687 | 901 | 1,008 | 946 | 1,123 | 1,006 |
| Hall Township including Dalzell, Ladd, Marquette, and Seatonville villages, and Spring Valley city | .... | 892 | 1,059 | 1,058 | 5,683 | 9,844 | 12,493 |
| Dalzell | .... | .... | .... | .... | .... | .... | 949 |
| Ladd | .... | .... | .... | .... | .... | 1,324 | 1,910 |
| Marquette | .... | .... | .... | .... | .... | .... | 494 |
| Seatonville | .... | .... | .... | .... | 536 | 909 | 1,370 |
| Spring Valley | .... | .... | .... | .... | 3,837 | 6,214 | 7,035 |
| Indian Township including part of Tiskilwa village | 459 | 1,009 | 1,660 | 1,507 | 1,277 | 1,271 | 1,093 |
| La Moille Township including La Moille village | 462 | 1,152 | 1,408 | 1,391 | 1,312 | 1,345 | 1,289 |
| La Moille | .... | .... | .... | 488 | 516 | 576 | 555 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Leepertown Township including Bureau village | .... | 299 | 387 | 450 | 556 | 715 | 654 |
| Bureau | .... | .... | .... | 240 | 363 | 545 | 534 |
| Macon Township | 74 | 689 | 839 | 768 | 731 | 692 | 743 |
| Manlius Township including Manlius village | 75 | 611 | 973 | 984 | 810 | 793 | 912 |
| Manlius | .... | .... | .... | .... | .... | .... | 218 |
| Milo Township | .... | 1,028 | 1,118 | 990 | 792 | 731 | 741 |
| Mineral Township including Mineral village | 142 | 852 | 1,034 | 997 | 905 | 1,258 | 1,018 |
| Mineral | .... | .... | .... | 173 | 188 | 339 | 349 |
| Neponset Township including Neponset village | 101 | 939 | 1,510 | 1,467 | 1,209 | 1,224 | 1,267 |
| Neponset | .... | .... | .... | 652 | 542 | 516 | 542 |
| Ohio Township including Ohio village | 183 | 1,078 | 1,137 | 1,314 | 1,197 | 1,322 | 1,353 |
| Ohio | .... | .... | .... | 385 | 364 | 461 | 527 |
| Princeton Township including Princeton city | 777 | 3,593 | 4,363 | 4,810 | 4,491 | 4,886 | 5,227 |
| Princeton | .... | 2,473 | 3,264 | 3,439 | 3,396 | 4,023 | 4,131 |
| Selby Township including Depue and Holloway villages | .... | 1,673 | 1,497 | 1,684 | 1,565 | 1,662 | 2,418 |
| Depue | .... | .... | .... | 323 | 455 | 488 | 1,339 |
| Holloway | .... | .... | .... | .... | .... | 207 | 196 |
| Walnut Township including Walnut village | 71 | 799 | 1,187 | 1,377 | 1,368 | 1,501 | 1,420 |
| Walnut | .... | .... | .... | 515 | 605 | 791 | 763 |
| Westfield Township including Arlington and Cherry villages | .... | 1,148 | 1,396 | 1,319 | 1,224 | 1,118 | 1,991 |
| Arlington | .... | .... | .... | 447 | 436 | 400 | 370 |
| Cherry | .... | .... | .... | .... | .... | .... | 1,048 |
| Wheatland Township | .... | 497 | 492 | 506 | 405 | 369 | 343 |
| Wyanet Township including Wyanet village | 383 | 1,496 | 1,750 | 1,800 | 1,510 | 1,803 | 1,665 |
| Wyanet | .... | .... | .... | 737 | 670 | 902 | 872 |
| **Grundy County** | 3,023 | 10,379 | 14,938 | 16,732 | 21,024 | 24,136 | 24,162 |
| Au Sable Township including Minooka village | 370 | 857 | 927 | 1,019 | 869 | 970 | 855 |
| Minooka | .... | .... | .... | 416 | 360 | 424 | 361 |
| Braceville Township including Braceville village, Central City, and parts of Coal City and Diamond and Godley villages | 93 | 607 | 1,188 | 1,906 | 5,638 | 5,224 | 4,205 |
| Braceville | .... | .... | .... | 278 | 2,150 | 1,669 | 971 |
| Central City | .... | .... | .... | .... | 673 | 290 | 287 |

TABLE 6.—*Population in upper Illinois Valley by decades from 1850 to 1910*—Concluded

| Area | 1850 | 1860 | 1870 | 1880 | 1890 | 1900 | 1910 |
|---|---|---|---|---|---|---|---|
| Braceville Township—Concluded | | | | | | | |
| Total for Coal City in Braceville and Felix townships | .... | .... | .... | .... | 1,672 | 2,607 | 2,667 |
| Total for Diamond in Braceville and Felix townships | .... | .... | .... | .... | .... | 672 | 255 |
| Total for Godley in Braceville Township, Grundy County, and in Reid Township, Will County | .... | .... | .... | .... | 296 | 329 | 194 |
| Erienna Township | 150 | 383 | 337 | 259 | 292 | 245 | 312 |
| Felix Township, including Carbon Hill and Eileen villages, and parts of Coal City and Diamond village | .... | 605 | 616 | 882 | 1,720 | 3,474 | 2,711 |
| Carbon Hill | .... | .... | .... | .... | .... | 1,252 | 820 |
| Eileen | .... | .... | .... | .... | .... | .... | 677 |
| Garfield Township including Gardner village | .... | .... | .... | .... | .... | .... | 1,338 |
| Gardner | .... | .... | 940 | 786 | 1,094 | 1,036 | 946 |
| Goodform Township | 101 | 570 | 803 | 955 | 899 | 849 | 759 |
| Goose Lake Township | .... | .... | .... | .... | .... | 449 | 406 |
| Greenfield Township including East Brooklyn and South Wilmington villages | 97 | 531 | 1,645 | 1,673 | 2,010 | 2,579 | 3,287 |
| East Brooklyn | .... | .... | .... | .... | .... | .... | 446 |
| South Wilmington | .... | .... | .... | .... | .... | 711 | 2,403 |
| Highland Township including Kinsman village | 67 | 382 | 980 | 1,042 | 1,026 | 1,013 | 980 |
| Kinsman | .... | .... | .... | .... | 129 | 174 | 219 |
| Maine Township | .... | .... | .... | .... | .... | 341 | 337 |
| Mazon Township including Mazon village | 469 | 896 | 1,005 | 1,114 | 1,117 | 1,176 | 1,163 |
| Mazon | .... | .... | .... | .... | .... | 447 | 471 |
| Morris Township including Morris city | 625 | 2,247 | 3,251 | 3,571 | 3,745 | 4,328 | 4,601 |
| Morris | .... | 2,105 | 3,138 | 3,486 | 3,653 | 4,273 | 4,563 |
| Nettle Creek Township | 318 | 702 | 916 | 902 | 824 | 794 | 697 |
| Norman Township | 56 | 363 | 417 | 445 | 354 | 308 | 257 |
| Saratoga Township | 200 | 825 | 1,233 | 1,133 | 971 | 880 | 805 |
| Vienna Township | 258 | 783 | 900 | 1,052 | 939 | 865 | 844 |
| Wauponsee Township | 217 | 627 | 720 | 779 | 620 | .... | 606 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Putnam County** | 3,924 | 5,587 | 6,280 | 5,554 | 4,730 | 4,746 | 7,561 |
| Granville Township including Granville, Mark, and Standard villages | .... | 1,525 | 1,668 | 1,499 | 1,270 | 1,379 | 4,193 |
| Granville | .... | .... | .... | 260 | 148 | 320 | 1,391 |
| Mark | .... | .... | .... | .... | .... | .... | 1,025 |
| Standard | .... | .... | .... | .... | .... | .... | 793 |
| Hennepin Township including Hennepin village | .... | 1,713 | 2,144 | 1,734 | 1,417 | 1,431 | 1,226 |
| Hennepin | .... | .... | .... | 623 | 574 | 523 | 451 |
| Magnolia Township including Magnolia village | .... | 1,740 | 1,667 | 1,490 | 1,326 | 1,257 | 1,490 |
| Magnolia | .... | .... | .... | 305 | 287 | 264 | 368 |
| Senachwine Township | .... | 6C9 | 801 | 831 | 717 | 679 | 652 |

more than offset the loss in 24 out of its 37 townships. From 1890 to 1900 La Salle County added 6,878, of which the gains in five cities made up 5,520; during this decade 13 townships lost in population. From 1900 to 1910 the increase of population in the county was 2,356; seven cities added 6,857 in the face of heavy losses in 24 townships.

The population of Bureau County increased by 757 in the decade 1870 to 1880, 13 out of 25 townships losing. From 1880 to 1890 the county added 1,842. The coal mines of Spring Valley and Seatonville attracted 4,373 people in this decade, but a loss was registered in all but three of the 25 townships. From 1890 to 1900 the increase in Bureau County was 6,098, contributed almost entirely by the mining towns of Hall Township; a decrease was recorded in ten townships. From 1900 to 1910 the population of the county grew by 2,863; the industrial towns of the region added 5,210; 16 rural townships lost heavily. In Grundy County there was an increase of 4,292 from 1880 to 1890, due to the growth in Braceville and Felix townships, in the coal region. From 1890 to 1900 the county added 3,112, mostly in the coal-mining districts of Felix and Greenfield townships and in Morris. From 1900 to 1910, 14 of the 17 townships of the county lost heavily, but the growth of South Wilmington, Eileen, and East Brooklyn in the mining districts overcame the losses in the rest of the county.

Putnam County shows similar conditions; its population in 1860 was greater by 841 than in 1900, a loss of 15 per cent in 40 years. Between 1900 and 1910, coal mines were opened about Granville, and the county gained 2,815, or more than 59 per cent.

In Grundy County there has been no increase in agricultural population in the last thirty years, none in La Salle and Bureau counties in forty years, and none in Putnam County in fifty years. In most townships there has been a material decrease for several decades. In Grundy County, Saratoga Township has lost one-third of its population since 1870, and six townships have fewer inhabitants today than they had fifty years ago. In La Salle County, Brookfield and Freedom townships have lost 25 per cent since 1870, Dimmick Township 38 per cent, Meriden 41 per cent, Grand Rapids 42 per cent, and 25 out of 37 townships are settled less densely than in 1860. In no case are these townships regions of exhausted soils or abandoned farms. Choicer prairie land or finer farm homes scarcely could be found. The reason is not that the land will no longer support as many people as it once did, but that agricultural progress has enabled fewer people to do the work of a greater number with more economy. As a result, a good share of the population has moved to newer lands in the West or to the cities. As wealth has accumulated, individual holdings have grown, and the number of farms has been reduced. The following table shows the increase in the average size of farms in recent years:

*Average acreage of farms*

| County | 1880 | 1890 | 1900 | 1910 |
|---|---|---|---|---|
| Bureau | 147 | 158 | 162.3 | 160.1 |
| Grundy | 140 | 149 | 150.9 | 162.1 |
| La Salle | 137 | 149 | 151.5 | 154.8 |

Large-scale farming is becoming the rule, and with concentration of ownership tenant farming is on the increase.

In all its history there is no more significant event than this passing of the control of the region from the rural districts to the industrial centers, as shown by the preceding analysis of its population statistics. The new order of things inevitably will continue at least for a time. It is possible to effect further economy in farming by cultivating the prairie land on a still larger scale, and for a time the farm population therefore will decrease still more. On the other hand, many more people may be supported in this region by other industries. Only a tithe of the coal which underlies its western and southern portion has been removed. The splendid water powers of the upper Illinois and Fox rivers remain almost untouched. A waterway from the Lakes to the Gulf, once built, will give the region an efficient water route. The location of the region on a great natural route, its nearness to important markets, its productive farm lands, its great supply of coal, and its variety of other raw materials, as well as the permanent power supply in its streams—all these physical gifts guarantee to it a continued development. Upon these material things is based the assurance of a splendid future for upper Illinois Valley, in the realization of which factory, mine, and farm each will bear an important part.

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